# The MINING CONGRESS JOURNAL

*Volume 13* MARCH, 1927 *Number 3*

*Loomis Colliery, Glen Alden Coal Company*


## 3000 Ton Rheolaveur Coal Cleaning Plant Installed In Existing Anthracite Breaker Saves Its First Cost In 100 Days

¶ Let us send you details of this achievement. ¶ Also see article in this issue giving results of Rheolaveur washing coal for metallurgical purposes. ¶ We can show you how your profits can be increased by the Rheolaveur system of coal washing.

AMERICAN RHEOLAVEUR CORPORATION

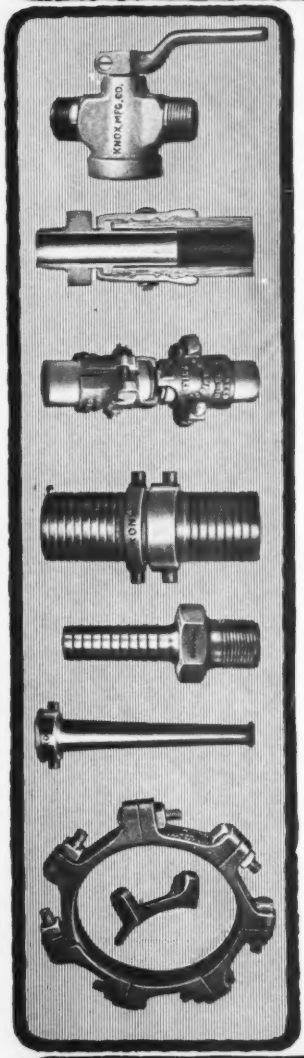
NEW YORK OFFICE, 120 BROADWAY WILKES-BARRE OFFICE, 911 COAL EXCHANGE BLDG.

# KNOX

**Valves-Couplings-Nipples-Clamps-Menders**

## MINING SPECIALTIES

## The World's Standard

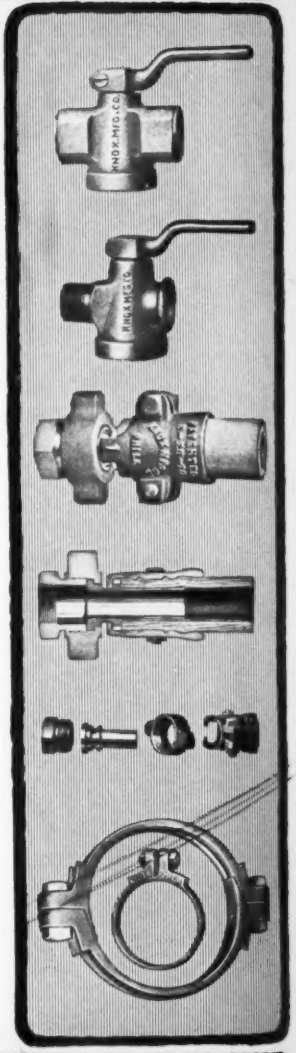


Knox Valves and Couplings verily are "Silent Sentinels."

From their very inception they are educated to abhor the hiss of escaping steam or air.

Before they migrate to the four corners of the earth, they are fortified with a post-graduate course in "Silence."

Their training is drilled and reamed and machined into them until the knowledge fairly radiates from them that where they are going Silence is Golden.



**KNOX MANUFACTURING CO.**

INCORPORATED 1911

817 Cherry St. Philadelphia, Pa.

Four track tipple and dry cleaning plant loading Egg, Stove, Mine Run and Slack, Berwind-White Coal Mining Company, Eureka Mine, No. 37, Windber, Pennsylvania

# Reduce the ash content in your fine sizes— Pennsylvania dry cleans coal

400 tons of small sizes—under 3½"— go through the Arms Dry Cleaning Plant of the Berwind-White Coal Mining Company every hour.

Whether your market is among industrial or by-product plants, or in the domestic field, Arms Screening and Arms Cleaning is a strong sales argument. Arms Screens thoroughly separate the sizes. Arms Air Concentrators will automatically—mechanically—remove all free foreign matter and leave the coal **dry.**

Arms equipment presents other advantages, such as small space requirements, low first cost, and low operation cost. These are well worth looking into and are fully described in Bulletins 74, 75, 77, 86, which will be sent on request.

## ROBERTS AND SCHAEFER CO.

ENGINEERS AND CONTRACTORS

418 Oliver Building PITTSBURGH, PA.

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MINE TIPPLES, MARCUS PICKING TABLE SCREENS, ARMS DRY CLEANING PLANTS, ROTARY CAR DUMPERS, CAR HANDLING EQUIPMENT

# THE MINING CONGRESS JOURNAL

MARCH, 1927

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30c Per Copy

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**PRACTICAL OPERATING MEN'S DEPARTMENT**

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*Heat Treating Rock Drill Steel*

**Published Every Month by the American Mining Congress, Washington, D. C.**

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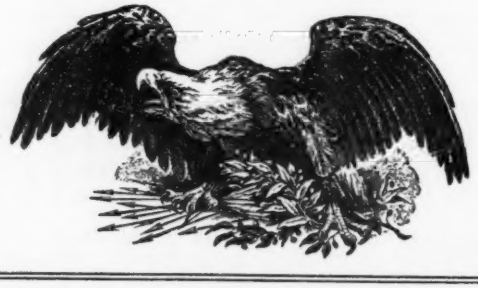

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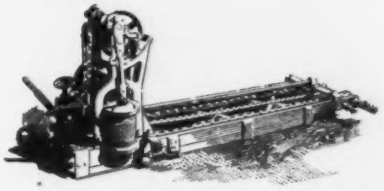
**Entered as Second Class Mail Matter January 30, 1915, at the Post Office at Washington, D. C.**

{··FIFTY·YEARS·AGO··}

# When Jeffrey built its First Coal Cutter.

Cable Cars and Whiskers



The First Jeffrey Coal Cutter

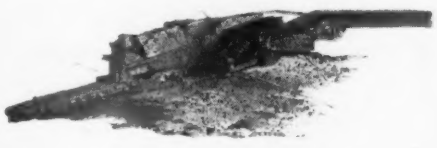
WHISKERED men, cable cars, cobble stone streets, and four story skyscrapers—that's the picture of the days back in the seventies, when Jeffrey was building its first coal cutter.

That first Jeffrey coal cutter was the forerunner of a half century of industrial progress unequalled in history. Today, practically every basic industry is dependent on coal production.

What the thousands of Jeffrey coal cutters built during the last half century have meant to industry is reflected in the rapid growth of coal production from an output of thirty-five million tons of bituminous coal in 1877 to an annual production of nearly six-hundred million tons today.

Modern Jeffrey coal mining equipment is complete from face to tipple. If you haven't a copy of our Coal Mining Catalog No. 386-B, write for one today.

A Modern Jeffrey Cutter and Loader



**The Jeffrey Manufacturing Co.**

958-99 North Fourth Street
Columbus, Ohio

50 YEARS OF SERVICE TO INDUSTRY

*Long Face Mining with the Conveyor-Loader*

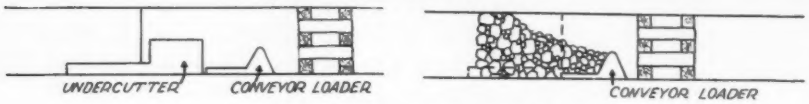
# A Better Grade of C

*The Jeffrey 44-B Conveyor Loader*

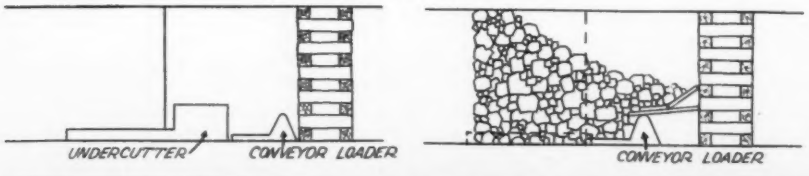
The photograph above shows the 44-B Conveyor-Loader advanced in an irregular outline to follow the contour of the shot coal.

At the right the Conveyor-Loader is discharging to a 47-A Sectional-Conveyor.

**Operating in a 3 Foot Vein**




**Operating in a 6 Foot Vein**




These diagrams illustrate how the Conveyor-Loader operates in a 3-foot and 6-foot vein. The space between the coal and posts is from 5 to 6 feet. A Longwall Machine does the undercutting and the Conveyor - Loader is placed directly behind it.

# JEFFREY

*oader Means—*

# Coal at a Lower Cost

ON a long face having a free end less powder is required to shoot coal than is necessary for a short face that is tight at both ends. There is less shattering of the coal, resulting in a better grade of large lumps.

To secure the greatest return from concentrated working, the coal should be loaded out quickly. This is best accomplished by means of a conveyor that remains close to the face, thus permitting close timbering which eliminates the uncertainties of roof control.

Being narrower than any other device available for loading out coal, the Jeffrey 44-B Conveyor-Loader meets these requirements, but further than this, it is so constructed that it will not be damaged by any reasonable fall of coal, rock or slate. The rock can be conveyed away immediately and the conveyor is again ready to load out the coal.

The Conveyor-Loader will load out over half of the coal without shoveling. Coal can be shot directly onto the conveyor. After the coal, which falls on the conveyor, has been loaded out the conveyor can be moved forward, making it unnecessary to carry that portion of the coal which must be shoveled. Large lumps can be rolled on without lifting them.

Its flexible design permits the conveyor to follow closely the irregular contour of the shot coal.

This machine cannot be overloaded. It positively carries away all coal at as fast a rate as it can be loaded onto the conveyor.

The Conveyor-Loader carries the coal to a 47-A Sectional Conveyor which, in turn, empties into a train of cars on the entry.

*Use of the Conveyor-Loader results in a reduction of the cost per ton in two ways:*

First—Direct cost of labor to cut, drill, load, and convey the coal is reduced by increasing the average output per man. This saving is considerable even after making ample allowance for depreciation, maintenance, and interest on investment.

A very substantial saving is also made in general maintenance cost. The actual working area is cut to a small fraction of that required in ordinary room and pillar systems for the same tonnage. This reduces the cost of ventilation, drainage, trackage, keeping haulage ways open, timbering inspection and other items of overhead cost.

We will be glad to send you further information, or if you desire a Jeffrey Sales Engineer will go over your mine with you to determine your possible savings with the Conveyor-Loader.

*Other Jeffrey Equipment for Concentrated Mining is shown on the next page*

# Coal Mine EQUIPMENT

# Other Jeffrey Equipments for Concentrated Mining

**The Shortwaloader—For use in room or entry. Cuts, loads, and conveys. Stays right on the job until room or entry is worked out. Operates continuously, except during shooting. In the above illustration the machine is shown ready to load across face.**

**Sectional Conveyor—Carries coal from Shortwaloader to a fixed loading point where it discharges into mine cars. Made in 6 ft. sections to follow steady advance of mining machine. In long face mining coal is received from Conveyor-Loader and carried to cars on entry.**

**Portable Conveyors—for service between Shortwaloader and Sectional Conveyor when drawing rib or working in wide rooms, also used as face conveyor for hand loading. Built in two types: Belt Construction for hand loading and Chain Construction for machine or hand loading.**

**Pit Car Loader—for rooms where delays due to taking down top rock, etc., make use of a more complete system of loading machines and conveyors impractical. Three times as much coal can be loaded with this machine as by shoveling direct to cars.**

*Catalog No. 425-A completely describes these Jeffrey Equipments for Concentrated Mining*

## The Jeffrey Manufacturing Company

958-99 North Fourth St., Columbus, Ohio

New York, Philadelphia — Pittsburgh, Scranton, Pa. — Charleston, W. Va., Chicago — Denver, Salt Lake City — Birmingham, Montreal, Canada

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Terre Haute, Ind.....319 Cherry Street
Salt Lake City.....153 W. Second South Street
Birmingham.....26 South 20th Street

50 YEARS OF SERVICE TO INDUSTRY

# JEFFREY
## COAL MINE EQUIPMENT

**Jeffrey-Standard Coal Mine Equipment**

Coal Cutters
Combination Cutter and Loader
Drills
Conveyor-Loader
Sectional Conveyor
Pit Car Loaders
Locomotives
Mine Fans
Tipple Equipment
Crushers

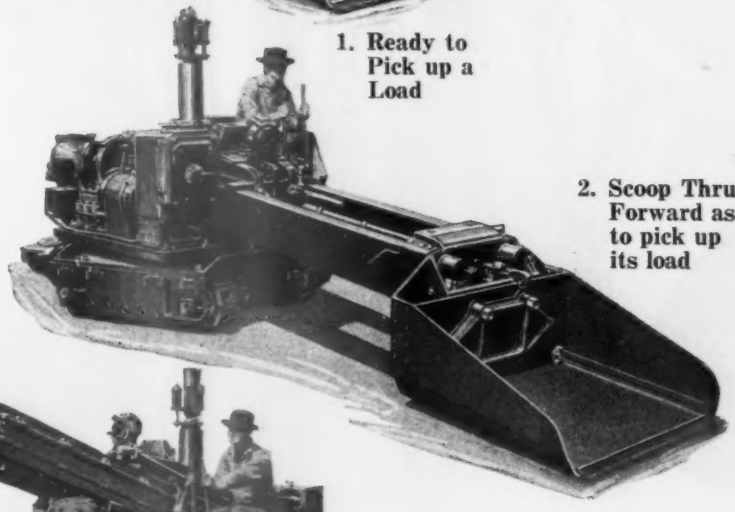
# If You Had a Man who

could wield a half-ton scoop, putting a half ton (coal) into a mine car every few seconds, all day long—

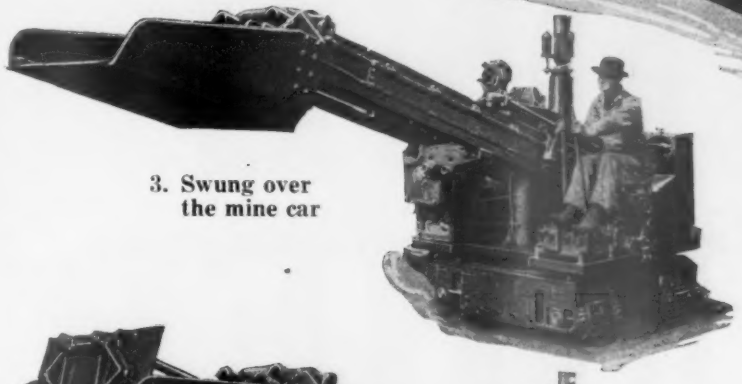
What would such a man be worth to you?

Well—
Just such a Giant Man is the Goodman Electro-Hydraulic Power Shovel

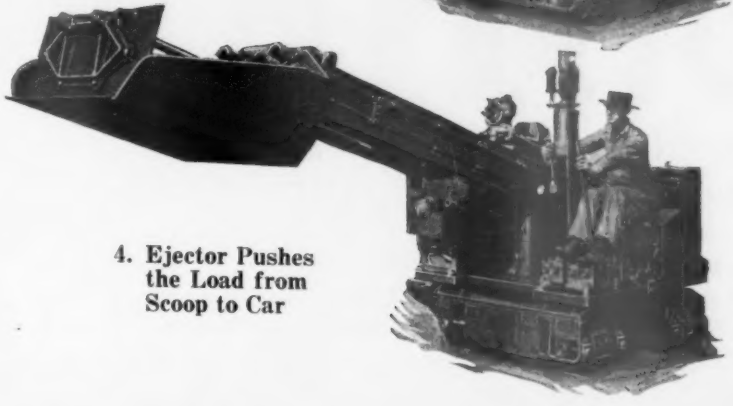
1. Ready to Pick up a Load



2. Scoop Thrust Forward as to pick up its load



3. Swung over the mine car



4. Ejector Pushes the Load from Scoop to Car

**A Powerful, Fast, Well-Proved Loader**

The thorough mine inspection always made before a Power Shovel is sold is one reason why every loader of this type installed is in operation and making money for the purchaser.

(39)

**GOODMAN MANUFACTURING COMPANY**
HALSTED ST. at 48TH
CHICAGO---ILL.

**Locomotives - Loaders - Coal Cutters**

PITTSBURGH – CHARLESTON, W.VA. – HUNTINGTON, W.VA. – CINCINNATI – BIRMINGHAM – ST. LOUIS – DENVER – PRICE, UTAH

—a new intermediate crusher with a capacity

# SYMONS CONE CRUSHER

(~A new but a proven correct principle)

*If a uniform size is wanted for rod or ball mill feed or leaching ~~ you should know the reasons for the CONE and*

—why the CONE has the greatest capacity!
—why the CONE produces a uniform product!
—why the CONE is easily adjusted for different size product while crushing!
—why the CONE is proof against tramp iron!
—why the CONE crushes with a wet or dry process!
—why the CONE manganese parts wear evenly!
—why the CONE is more economical to operate!

*All of this, and more, is told in our NEW catalog — write for a copy today.*

## SYMONS BROTHERS

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CALIF.

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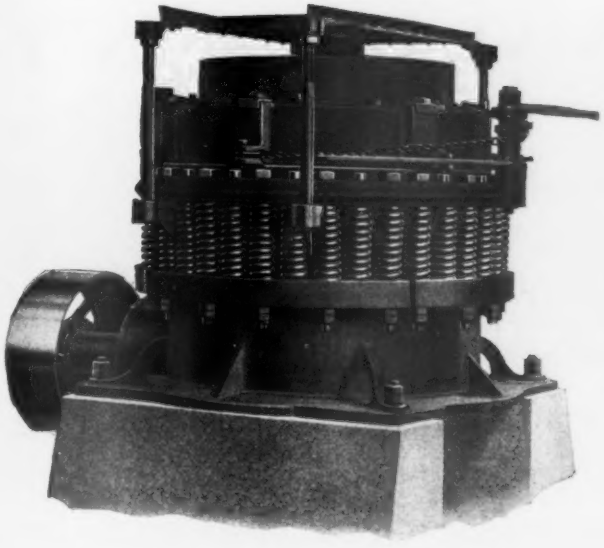
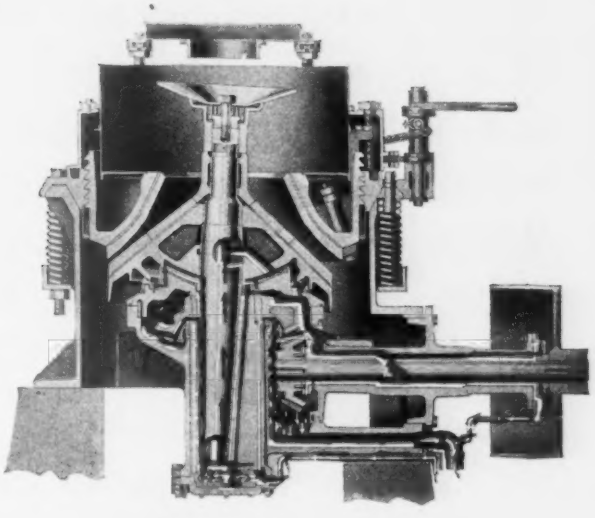
CHICAGO,
ILL.



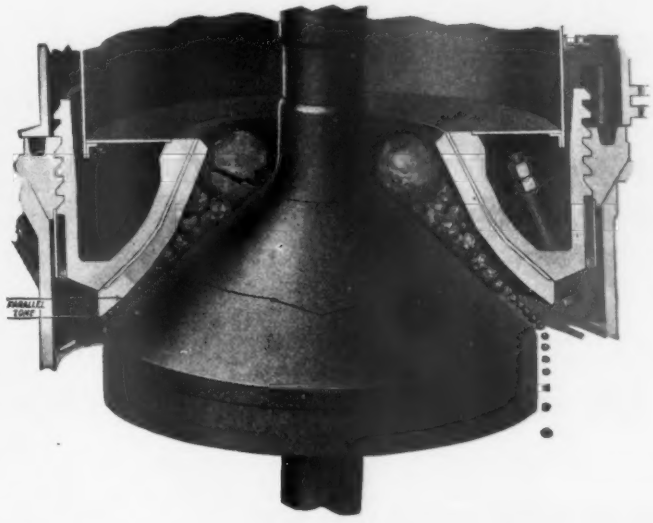
The CONE is a new but a proven correct crushing principle—and in the CONE Crusher is combined, in one machine, the advantages of both the Symons *Horizontal* and *Vertical Disc* Crusher.

The *large ratio of reduction* of the Horizontal, the *fine, uniform product* of the Vertical, and the *capacity of both* are points of advantage recognized by hundreds of users.



The *long heavy springs* that hold the bowl rigidly in position, when crushing, are flexible enough to allow the bowl to raise the full movement of the head when tramp iron or other non-crushable material enters the crushing cavity.

All bearings automatically lubricated at the rate of several gallons per minute.



The shape of the outer bowl and long gyration of the conical head allow timing against gravity.

The *closed* side of the crusher regulates the *maximum* size of the product.

# COMPANY

51 EAST 42nd STREET
NEW YORK,
N. Y.

**Cone**
~
**Vertical Disc**
~
**Horizontal Disc**

# ASK IF WE CAN SAVE YOU MONEY

Hercules Explosives are used in most of the mining and quarrying districts of the United States. The regular grades are recognized as standard equipment. The special grades have been the means of reducing explosives costs for many operators who have given them a trial.

If you have not already determined whether one of the Hercules Special Dynamites—No. 1 and No. 2 for open work and No. 3 for underground—are adapted for your work, we recommend an examination of your blasting operations. Where these special powders are suitable they show an appreciable saving for the user. Perhaps the proper one of them can do so for you.

The same thing can be said of Hercoblasting, a method for shooting black powder in column loads with Cordeau Bickford, in welldrill holes that often saves as high as thirty percent on explosives costs in open-pits and quarries.

We are gradually adding new names to the long list of companies that are increasing their profits through savings brought about by Hercules service, or Hercules explosives, or both.

Naturally we extend our service first to those who ask for it. It will cost you nothing to ask, and it may prove to be a profitable request.

***HERCULES POWDER COMPANY***

*(INCORPORATED)*

*Dynamite—Permissible Explosives—Blasting Powder—Blasting Supplies*

934 King Street Wilmington, Delaware

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WILKES-BARRE

# THE EXPLOSIVES ENGINEER— FORERUNNER OF PROGRESS

The title of this advertisement is also the title of a motion picture film that illustrates the part played by men who move materials with explosives in the great industrial undertakings of our times. It shows how engineering methods have transformed blasting from an uncertain, hit-or-miss operation into a science based on mathematical calculations. It illustrates the opportunities in this newest branch of the engineering profession.

More than this: it takes you behind the scenes in the great testing laboratories maintained by the United States Bureau of Mines and by one of the largest manufacturers of explosives, and shows you the exacting care with which explosives are tested in order that the tools of the explosives engineer may be as dependable as his figures.

"The Explosives Engineer—Forerunner of Progress" is contributed to the cause of industrial education. Together with another new Hercules film it will provide an evening of dramatic and instructive entertainment.

The other new film dispels the mystery that has heretofore surrounded the manufacture of electric blasting caps. This film clearly shows the manufacture and features of the Hercules Electric Blasting Cap. It illustrates the marked advantages of the larger diameter cap shell, adequate water-proofing, and platinum bridge.

Upon request, either or both of these films will be loaned without charge. Please let us know the date on which you wish to make your showing and we shall forward one or both, prepaid. Kindly use the coupon.

## *HERCULES POWDER COMPANY*

*(INCORPORATED)*

*Dynamite—Permissible Explosives—Blasting Powder—Blasting Supplies*

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WILKES-BARRE
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HERCULES POWDER COMPANY,
934 King Street, Wilmington, Delaware
I should like to show your film (or films):

☐ "The Explosives Engineer—Forerunner of Progress."
☐ "The Manufacture of Electric Blasting Caps."

on..... before .....

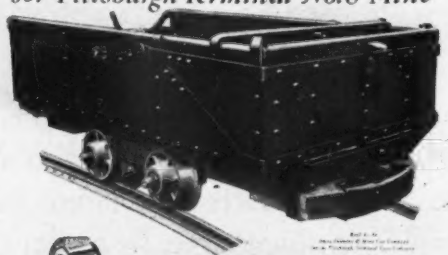
Name.....

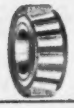
Position.....

Address.....

# The Greatest Makers —The Greatest Users

## 800 Timken-Equipped Cars
*for Pittsburgh Terminal No. 8 Mine*





Leading manufacturers like the Ira-Foundry & Mine Car Company engineer mine cars around Timken Bearings. Great operators like the Pittsburgh Terminal Coal Company are heavy investors in Timken-

...source of wheel wear, rail damage and derailment danger.

For alignment is permanently preserved under all conditions of thrust, shock, speed and weight, by the

## From Face to Railroad on Timken Bearings

A world-famed operator like the Pittsburgh Coal Company—a high-efficiency property like their Warden Mine—and it is only to be expected that Timken Tapered Roller Bearings will be most widely used throughout the equipment.

All the Warden mine cars, built by American Car and Foundry Company, run on Timken Bearings. All the conveyors, the loading booms, the whole Warden tipple—designed by Allen & Garcia—are Timken-equipped. It is perhaps the most emphatic preference ever expressed for Timken Bearings in all their dominance of the mining field.

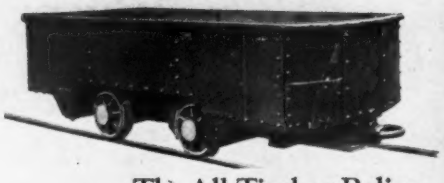
Everywhere, in all types of equipment, Timkens save power by eliminating excess friction. Timkens save labor and material by running for months or years on each greasing. Timkens provide the higher load capacity of Timken tapered design and Timken positive roll alignment. Timkens add all the endurance of Timken-made steel. And Timkens permit economical, simple, accessible design, because they carry *thrust*.

All the Timken economies can be yours, since so many leading makes of cars, conveyors and other equipment are designed around Timken Bearings.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

**TIMKEN** *Tapered Roller*

## TIMKEN *Tapered Roller* BEARINGS

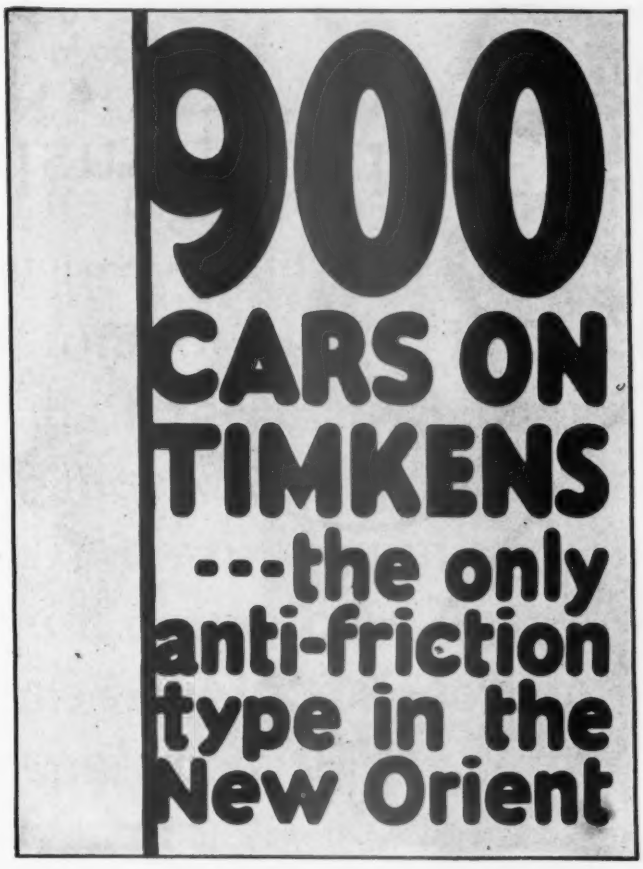


## The All-Timken Policy

Into its new Warden Mine the Pittsburgh Coal Company put 700 Timken-equipped cars, designed by Allen and Garcia and built by American Car and Foundry Company. It is another example of how Timken-mounted cars are being adopted by leading engineers and operators, often to the exclusion of

...every sort. Always the Timkens retain, emphasize economies. Cars stay at work with unheard of regularity. Grease consumption becomes next-to-nothing. Labor likes these easy-moving cars. Safety is increased. Batteries or animals are saved. Even the trade is protected, for Timkens prevent misalignment.

# TIMKEN *Tapered Roller*




The most highly developed designs of all good mine car makers provide for the use of Timken Tapered Roller Bearings.

The most highly developed properties of great operators in every field are largely or wholly on a Timken-equipped basis.

The rising preference for Timken Bearings is today one of the outstanding factors in progressive mining engineering.

Timken Tapered Roller Bearings are universally specified because they are more than anti-friction bearings. Their easy-starting, easy-rolling properties save labor, power, and lubricant. But their inherent thrust capacity, *POSITIVELY ALIGNED ROLLS* and Timken-made steel also add load capacity and matchless endurance.

Without auxiliary parts, or any moving contact with axle or bore surfaces, the entirely self-contained Timken Bearing carries all stresses, from all directions, with equal facility. Most readily enclosed, compact mountings are possible, adding economy and refinement of construction to improved low-cost operation.

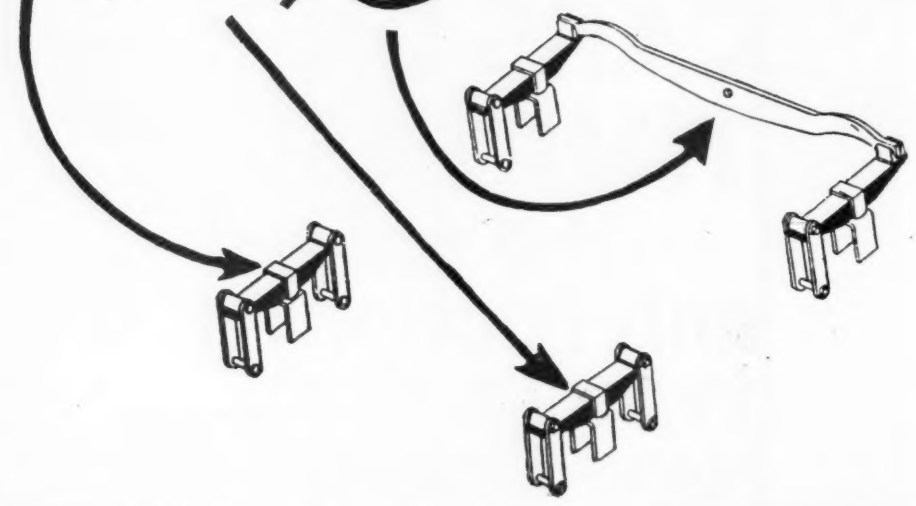
Such betterments follow Timkens not only into mine cars, but also into all forms of conveyors, motors, hoists and other equipment, sponsored by leading makers.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

# BEARINGS

# For long life—

# 1, 2, 3 point suspension

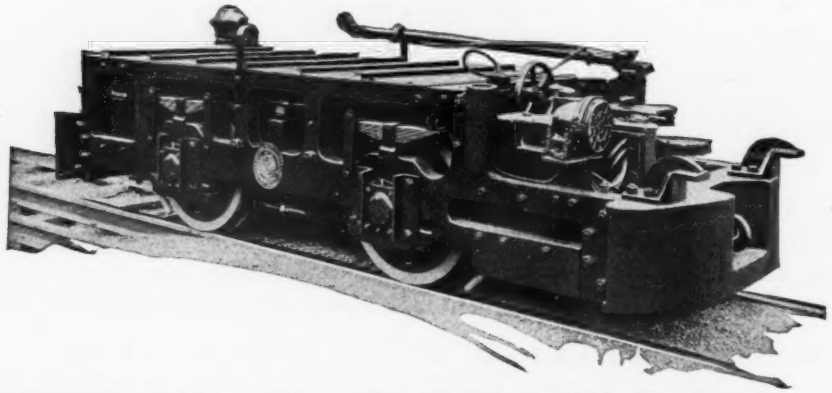


THE 3-point Suspension feature of the Vulcan Trolley and Storage Battery Locomotives eases the shocks, decreases wear to the irreducible minimum, cuts maintenance and does away with the usual danger of derailments.

It's this same feature which has done so much to make possible the 30- and 40-year service records of the Vulcan Steam Locomotive.

This 3-point Suspension of the entire chassis is an exclusive feature of the Vulcan Electric Locomotive. One pair of springs supports the frame through hangers. The other pair of springs is held by hangers and an equalizing bar extending across the machine and supported in the center. By means of this arrangement shocks are absorbed. the weight is evenly distributed and the locomotive runs smoothly over any ordinary inequalities of track.

***Get in touch with us so that we can explain in detail about the Vulcan 3-point and what it will do to solve your locomotive problem.***



**VULCAN IRON WORKS** OF Wilkes-Barre, Pa. U.S.A.

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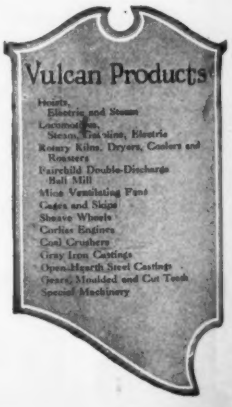
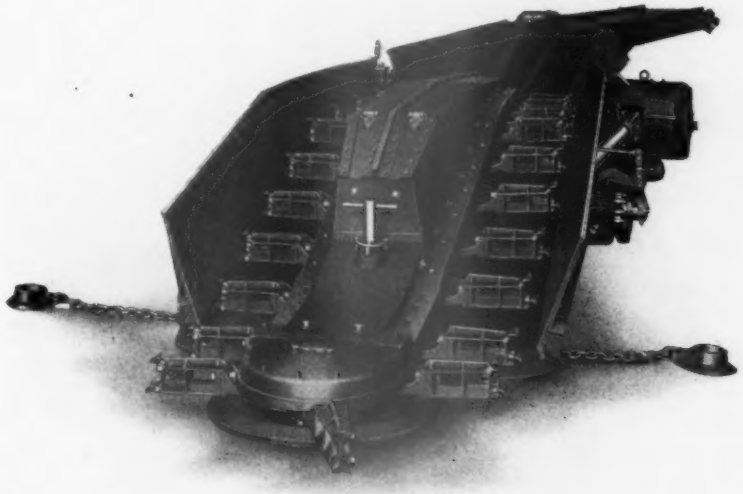


# THE COLODER

Delivers its high tonnage reliably. This has been proven in the loading of millions of tons of coal. This reliability insures all of the many benefits obtainable with mechanical mining—minimum cost per ton—minimum working area—minimum timber cost—better working conditions—rapid development—high tonnage per man.



*Our Mining Engineering Department will gladly examine your mining conditions.*

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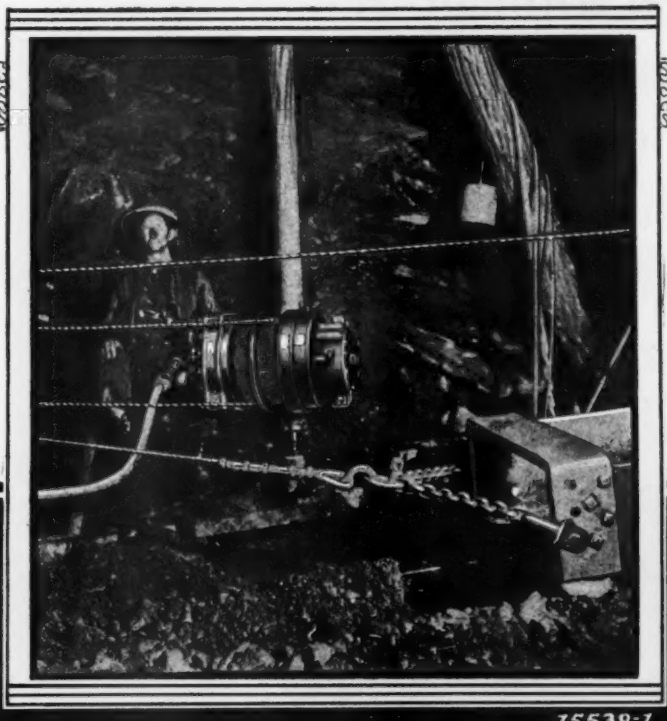
## THE COLODER COMPANY, Inc.

568 NORTH FOURTH STREET COLUMBUS, OHIO, U.S.A.

# MINE METHODS-SCRAPING, LOADING and HAULING Revolutionized by "LITTLE TUGGER" HOISTS



**6-H "Little Tugger" Hoist**

*From prehistoric days until within the last few years no great improvement was made in that important major mining operation of mucking and loading.*

*The necessity for lower costs and greater production has finally and definitely replaced hand shovelling by "Little Tugger Slushing" in many mines throughout the world.*

*Request Bulletin No. 4036*

## "Slushing" Saves 50% of the Costs

### Muck and Tram Mechanically

Hand mucking or shovelling consumes 35% to 45% of the *total* mine working time.

"Little Tugger Slushing" has been successfully applied in practically every method of modern mining without any change in the original mine layout and with appreciable savings in mucking and loading time.

However, if in planning the layout for a new level, arrangements are made to take the greatest advantage of "Little Tugger Slushing," the latter can be counted on to reduce the time to from one-half to one-fourth the time consumed by hand shovelling methods and with a corresponding reduction in labor.

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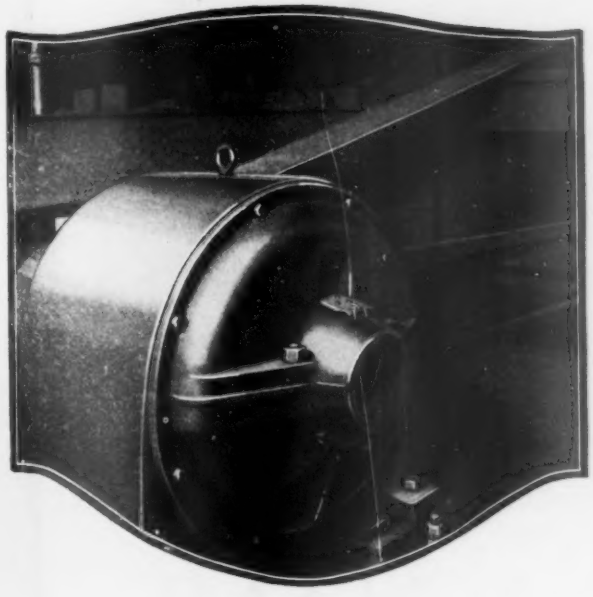
# Ingersoll-Rand

# Electrification—

## *the first essential in cutting your coal "manufacturing" costs*



Today's high wages, mining costs and keen competition severely handicap mining companies who continue their inefficient coal "manufacturing" methods.

Electrification is the first essential in cutting your coal-preparation costs. Motor drive your conveyors, crushers, jigs, shakers as well as your pumps.

G-E Motors are built especially for this type of work—impervious to coal dust, moisture and acid water. Their sturdy, balanced mechanical and electrical construction makes them exceptionally trouble-free—and unfailing.

G-E engineers, trained in the field, will gladly help you select the sizes and types of motors your tipples or breakers require. Ask your nearest G-E sales office for this service.

General Electric supplies equipment for all phases of coal mine electrification. Consider G-E apparatus whenever your requirements are electrical—for G-E installations pay you as surely as good investment bonds. Your nearest G-E office has coal mine specialists always at your service.

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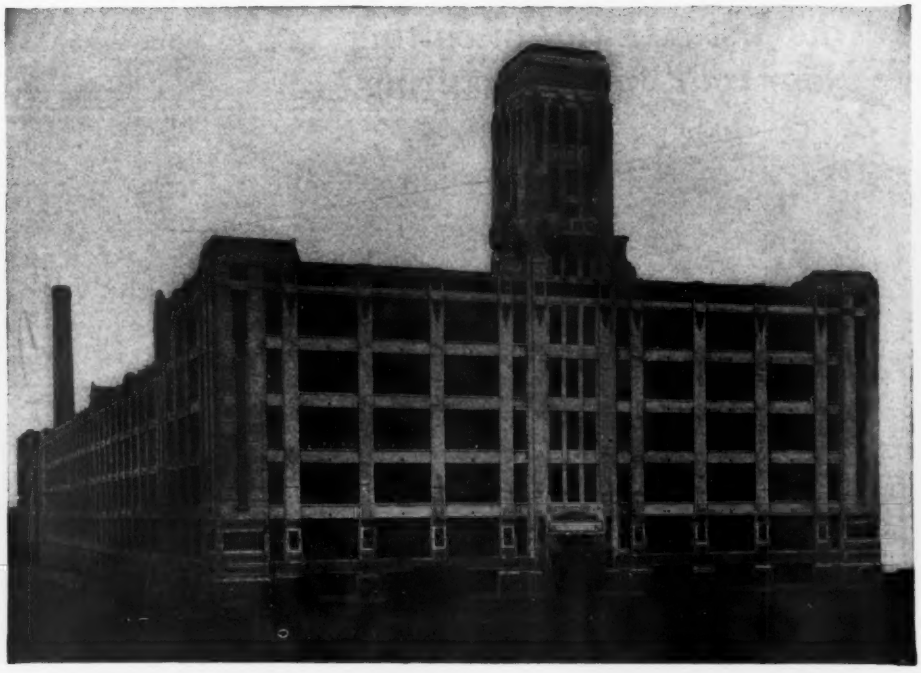
# GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN ALL LARGE CITIES



# BACK OF A NAME

*"Ship one ton of Union Carbide."*

**So say hundreds of customers. Not "calcium carbide." Not "carbide." But always "Union Carbide."**

This is because they know that Union Carbide is always the same—a quality product, the world's standard. They know that the great central laboratory is forever vigilant, always zealous that Union Carbide quality be maintained. They know that the control laboratories in every carbide works never relax their watch. They know that for nearly thirty years Union Carbide quality has always been faithfully maintained.

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UNION CARBIDE WAREHOUSES IN 180 CITIES

# Blue Center Steel Wire Rope

Roebling Blue Center Steel Wire Rope is the ultimate choice of discriminating buyers for every purpose for which wire rope is used

*Catalog A-500*

John A. Roebling's Sons Company

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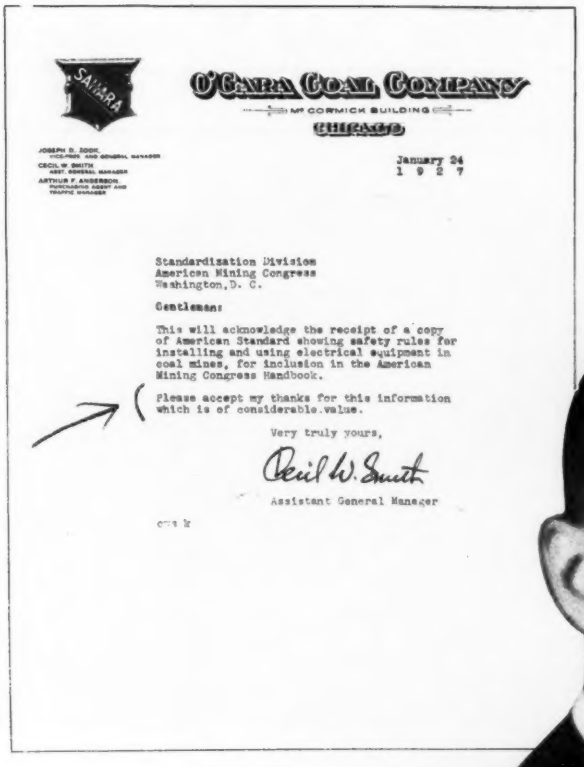
# "Please



O'GARA COAL COMPANY
McCORMICK BUILDING
CHICAGO

JOSEPH D. DOCK
VICE-PRES. AND GENERAL MANAGER
CECIL W. SMITH
ASST. GENERAL MANAGER
ARTHUR F. ANDERSON
PURCHASING AGENT AND TRAFFIC MANAGER

January 24
1 9 2 7

Standardization Division
American Mining Congress
Washington, D. C.

Gentlemen:

This will acknowledge the receipt of a copy of American Standard showing safety rules for installing and using electrical equipment in coal mines, for inclusion in the American Mining Congress Handbook.

Please accept my thanks for this information which is of considerable value.

Very truly yours,

Cecil W. Smith

Assistant General Manager

cms k

*Cecil W. Smith*
*Assistant General Manager*

**The O'Gara Coal Company, operating nine mines in Saline County, Illinois, and employing 3,000 men, has a daily output capacity of over 19,000 tons. Their mining equipment includes chain, breast, over cutter and short wall machines, and trolley and storage battery type locomotives. Below are three views of the plant, tipple and loading equipment at No. 10 mine.**

*Mine No. 10—Capacity, 2,000 Tons of "Sahara" Coal Daily*

# *accept my thanks for this information which is of considerable value"*

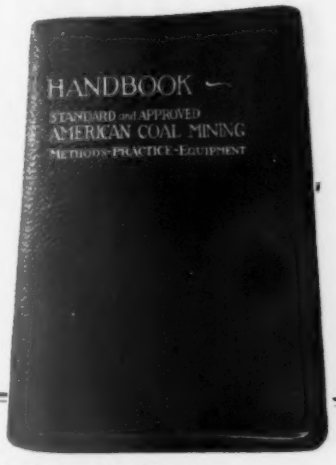
LETTERS such as this are coming from the practical and conservative men who are directing operations in all the coal mining fields of the country. They indicate by their approval of the Handbook of Standard and Approved Coal Mining Practice the value that is put upon this movement for reducing costs and improving efficiency.

In this handy and helpful book are authoritatively correlated, in practical working form, the findings of the nation-wide movement for standardization of coal mining methods, practice and equipment.

**SUBJECTS COVERED IN THE HANDBOOK**

**IMPORTANT SUBJECTS TREATED in the Handbook of Standard and Approved American Coal Mining Practice include: basic rules safeguarding electricity in mines; electric tipple equipment; underground stations (all phases of automatic control of mine equipment); trolley and storage battery type locomotives; mine tracks, signals, and switches, including track gauge, turnouts, frogs and switches; mine cars; mine fans; airways and shafts and booster fans; wire rope, ladders, and miscellaneous coal handling equipment; pumps for development work, permanent pumping stations, natural drainage, and effect of mine water on equipment; loading machines, belt, chain and shaking conveyors, installing and operating cutting and loading equipment; general mine timbering, preservation of timbers, and use of concrete and steel.**

*This Handbook is pocket size, loose-leaf, and will be kept up-to-date as recommendations are approved. Its price is $5. This includes a subscription to The Mining Congress Journal. For further information, address The American Mining Congress.*




**STANDARDIZATION DIVISION,**
**The American Mining Congress,**
**841 Munsey Building, Washington, D. C.**

**I am enclosing.....for.....copies of the Handbook of Standard and Approved American Coal Mining Methods, Practice Equipment—each order to include a subscription to The Mining Congress Journal.**

**Name.....**

**Street.....**

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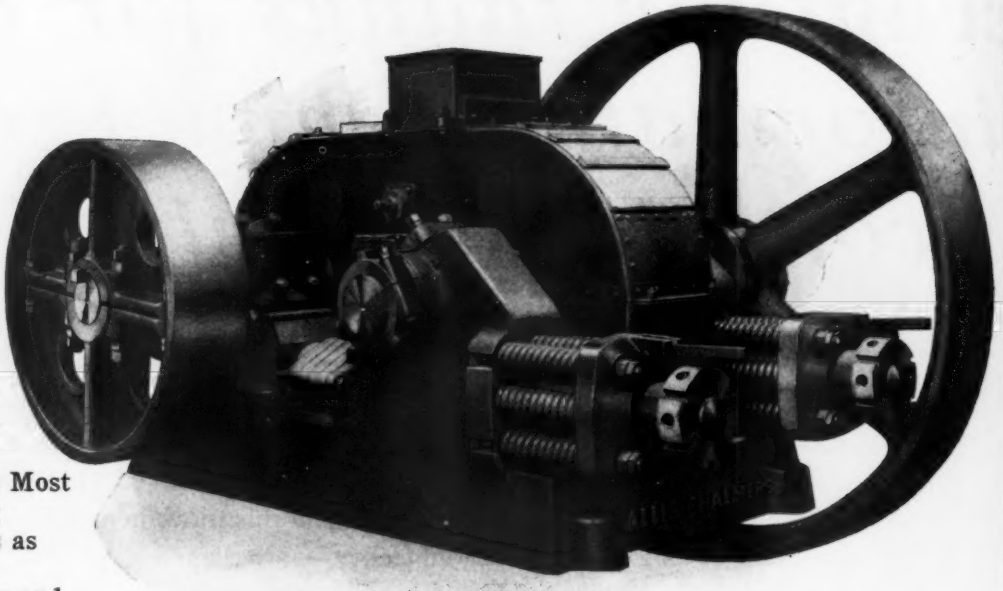
# TYPE "B" CRUSHING ROLLS



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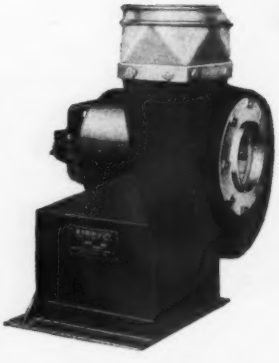
**Meet the Most Exacting Demands as to Duty, Efficiency and Reliable Service**

**ALLIS-CHALMERS MANUFACTURING COMPANY**
MILWAUKEE, WISCONSIN. U.S.A.

# Into *the* Mines~ *Goes a Steady Stream of Air!*

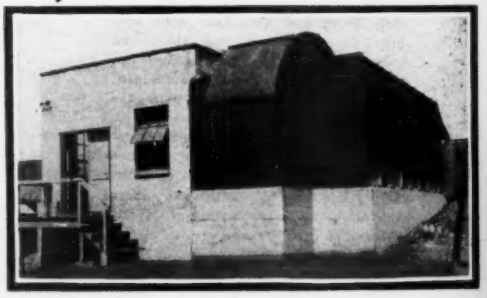
ROBINSON FANS are engineered and built to force a never failing supply of air to the working faces—to create that feeling of comfort and security that means improved morale, lower labor turnover, increased output, and decreased costs.



**Compact, substantial tubing blower, typical of the Robinson Fan Equipment available to meet every mine ventilation need. Well balanced, long lasting; arranged to discharge at any angle. Discharge nozzle, intake seal ring, and wheel are aluminum for long life.**

**WRITE FOR CATALOGUE**

No matter where you may be in the coal regions, there is a Robinson Fan in operation near you. During more than 30 years Robinson installations have been making friends for us and building up additional sales. Tell us your ventilation requirements and we shall be glad to make recommendations without obligation on your part.



**Robinson Fan Installation**
**Youngstown Sheet & Tube Company Brierhill Mine**
**Brierhill, Pa.**

**ROBINSON**
ZELIENOPLE Ventilating Co. PENNSYLVANIA

# Back to Byers!

## *Where wrought iron displaced steel*

IN a large metropolitan power station, pipe failures within a short span of years became very annoying. Investigation revealed the fact that it was ordinary "wrought" pipe. When this company built a new station, their engineers saw to it that genuine wrought iron was installed for many purposes where ordinary pipe was once supposed to be satisfactory.

This experience is duplicated in industrial and power plants in almost every part of the country. Specific instances are constantly called to our attention. Hence a distinct trend towards wrought iron is observed in all places where corrosion is a factor, and where pipe materials are chosen with due regard to the heavy cost of pipe failures.

*Distributors in All Jobbing Centers*

**A. M. BYERS COMPANY**

*Established 1864* Pittsburgh, Pa.

New York Detroit Philadelphia Boston Los Angeles
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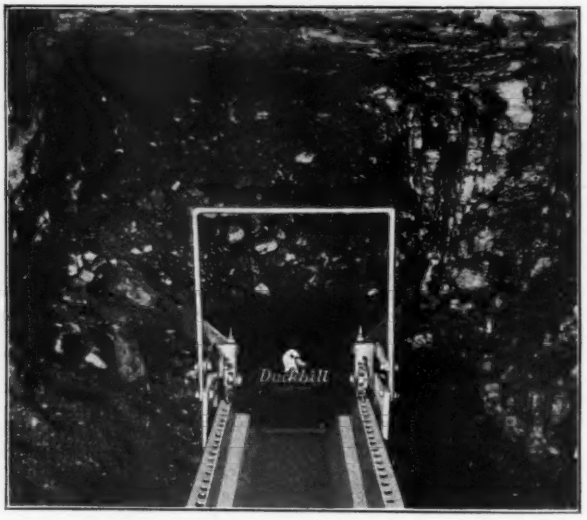
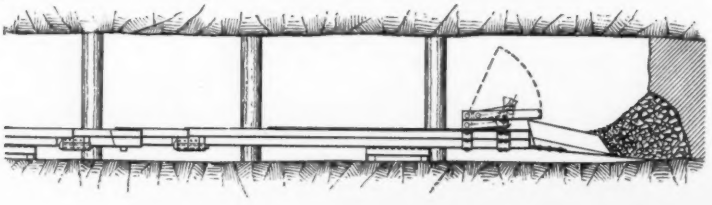


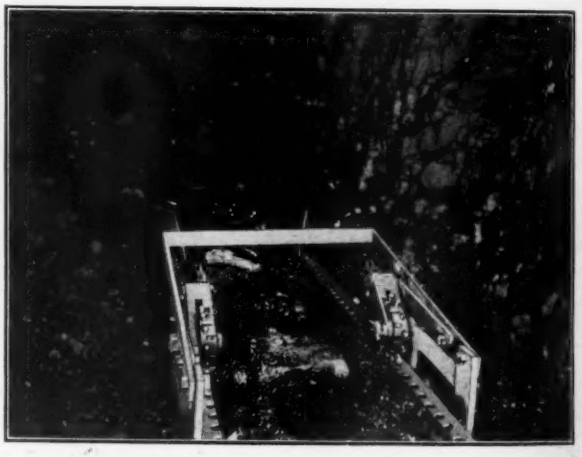

# *The* DUCK BILL
## Automatic Loading Attachment
in combination with
## Eickhoff
## Conveyor
*for Development Work*

# —*SPEED with LOW COST*



REMARKABLE speed and production in development work are attained with the Duck Bill attachment to the Eickhoff conveyor. No other loading device can boast such simplicity of construction, or such economy in operation. The Duck Bill practically eliminates hand loading. It is sturdy, easily portable, and needs no independent power. Being attached to the conveyor proper, the Duck Bill converts the Eickhoff into the most efficient "self feeding" conveyor on the market, yet costs only a twentieth the price of an ordinary loading machine.

ASK FOR BOOKLET 559



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# The MINING CONGRESS JOURNAL

PUBLISHED EACH MONTH BY THE AMERICAN MINING CONGRESS MUNSEY BLDG., WASHINGTON, D. C.

Subscription Rate: Per Year, $3.00 Single Copies: $0.30

VOLUME 13 MARCH, 1927 NUMBER 3


## REFUSE TO ARBITRATE

PERHAPS NO MORE difficult problem has ever been before any previous four states' joint bituminous wage scale conference than that which has been under consideration by the recent Miami conference — a problem of increasing difficulty measured by the gradual decline of coal production in Illinois, Indiana, Ohio and Western Pennsylvania and the rapidly increasing production of the coal fields south of the Ohio River.

At one time these four states produced the greater part of the bituminous coal consumed in the United States.

The development of the southern fields naturally divided these markets. An uncontrolled wage scale has made possible a lower production cost and southern production has nearly absorbed the domestic markets. The present controversy, therefore, is a life and death struggle on the part of the operators in the central competitive field. They realize that three years under the Jacksonville wage scale agreement has reduced their production to about one-third its previous record and they believe that to grant a two-year extension of that scale will practically put them out of business. The great overproduction capacity of the nation is being rapidly augmented in the southern field and the operators fully believe that another two years under the Jacksonville scale will see such further increase in the production capacity of the southern field as will enable it to furnish all the coal that can be consumed by the nation. Distance from markets might seem a handicap but this has been practically overcome by lower wage scales and by lower production costs resulting from more continuous operation. The operators of the northern field ask the United Mine workers to join them in an effort to regain the lost markets and to make possible something like their old time production and offer to submit the question to an arbitration board consisting of four miners and four operators to be selected by miners and operators, and three arbitrators to be chosen by the eight operators and miners if able to choose, and by the Chief Justice of the United States Supreme Court if the miners and operators are unable to agree.

The miners refuse to arbitrate and insist upon a renewal of the present scale although admitting that the past three years have been years of small production and limited employment.

The operators believe that the acceptance of their proposal is absolutely necessary to enable them to furnish employment to any large part of the men who depend upon the industry.

The miners feel that any present reduction in wages will be permanent and that to permanently accept a wage based upon an agreed percentage above the non-union wage would mean a continuous competition toward a lower wage scale.

The operators insist that just as soon as actual competition has been established that the southern field will find that lowering wages brings no advantage and that increasing wages brings no competitive disadvantage and will yield to that better business principle which pays the best possible wage which competitive conditions will permit.

This was the issue considered and upon which no agreement was reached.

## "MARK W. POTTER ON COAL"

THE CENTRAL competitive field of the bituminous coal industry is in the midst of a gigantic effort to find a solution of its problems. A recent communication from Mr. Mark W. Potter, to the Manufacturers Record, purports to have discovered the solution. If, as Mr. Potter points out, "All of the so-called problems of the bituminous coal industry can be solved, all deserving interests can be served and consumers can be saved hundreds of millions of dollars a year almost by the stroke of a pen" surely a struggling industry should grasp so simple a remedy.

On another page in this issue will be found the basic principles of this plan which is said to furnish a solution to a greatly perplexed and harrassed industry.

Such a statement from a man of Mr. Potter's vast experience and recognized ability can not fail to command public attention. Nevertheless it is difficult for us to apply it to the coal industry.

His suggestion hinges largely upon proper car distribution. From at least our standpoint it would seem that Mr. Potter believes that the coal business of the four states, Indiana, Illinois, Ohio and Western Pennsylvania, should be permanently sacrificed, and that "by a stroke of a pen" the property rights not only of the operators in the central competitive field, but of the owners of all surplus mines in other fields which have not yet been developed to the point of highest efficiency, should be confiscated.

So far as we have been able to learn there has been an abundance of idle cars in the central field at all times during the past three years; and we have heard no complaint of car shortages in the southern field; in fact, it is our belief that every consumer of coal in the United States has been able to exercise his right to purchase coal when and from whom he pleased, and without any consideration of the problem of car distribution.

But in spite of these obvious facts, and Mr. Potter's contention, the coal problem still exists, and most certainly it is not confined to the central competitive field.

The coal problem can not be settled by "a stroke of the pen"; it certainly can not be settled by any plan which spells ruin to any large minority. Any solution of the coal problem must take into consideration the potent fact that all coal for this and future generations is now in existence and available for immediate production. Coal's problems can only be solved through the cooperation of all owners of commercially possible production upon a basis which recognizes values present and remote.

**A SOUTHERN INDUSTRIAL CONFERENCE**

THE SECOND annual Southern Industrial Conference has been called to meet at the Tutwiler Hotel, Birmingham, Ala., March 21 and 22, 1927.

The very effective and successful meeting held at Memphis last year justifies the hope that the discussions at Birmingham will mark another step in the further progress of the South toward a full realization of the benefits of its immense mineral possibilities.

Concrete illustrations of the benefits of this work, as evidenced by new industrial plants now in operation as well as by negotiations in progress for the establishment of other new industrial activities; a review of the new resources which the year's work has developed and the possibilities of large industrial enterprises based thereon, and a general discussion of the means of further benefitting the South, will constitute the principal subjects for discussion.

We quote from a letter from one of the most aggressive and capable industrial departments of a great southern railroad as follows:

> "Undoubtedly the thing most needed to accomplish the end (the development of minerals in the South) is complete information as to the resources, the deposits and the practical uses of the materials. This means field work, research, laboratory and plant tests."

We fully agree with this suggestion, but the thing which we are sure the gentleman had in mind as being more important still is the diffusion of this information to possible investors who know how and have the money with which to develop industrial enterprises.

The conference will be open to all who have the interest of the South at heart and who are willing to do their part in cooperation with others in the South-wide effort for a higher and better development.

---

**THE SHORT SESSION OF CONGRESS**

FILIBUSTERS, LACK OF QUORUMS in the Senate, and efforts of various minority groups and coalitions to delay, prevent, or otherwise interfere with the disposition of pending legislation, marks the end of the 69th Congress.

It appears that the Swing-Johnson Boulder Dam Bill will be caught in the final jam; that the Muscle Shoals bills already are doomed; and that practically all bills except those carrying necessary appropriations will fall by the wayside.

Before the opening of the short session in December, business men and their organizations had hopes that it would be possible to take up the matter of reducing corporation income taxes. The large surplus in the Treasury justified this hope, and tax relief for corporations was and is supported by public sentiment throughout the country. But Congress turned a deaf ear to every proposal and plea.

The McNary-Haugen farm relief bill is probably the most important measure that has passed. The President has vetoed this bill on the ground that it is too costly, uneconomic, unconstitutional, and fails to provide a satisfactory solution of the situation in the agricultural industry.

The general opinion seems to prevail that the adjournment of the 69th Congress will be a welcome event; that the country needs a rest from the agitation that emanates from within and without Congress, the clouds of suspicion that rise out of the maze of charges and countercharges concerning the merits of this or that measure, the validity of certain elections, and the conduct of the administrative departments.

The political lineup in both Houses, during this session, has been uncertain. If the majority of both Houses of the next Congress divide on important questions as they have in this session, there is no way of predicting what may happen. The policy of economy of the present administration may be thrown to the four winds. It is fortunate for the country that the present session was too short for the consideration of all the uneconomic and expensive proposals introduced, which were designed to place the Government in business in competition with private enterprise.

---

**QUALITY vs. QUANTITY**

IN THE DAYS when Mark Twain defined a mine as "a hole in the ground, with a liar on top," only the cleanest and best seams of coal were operated and preparation concerned itself only with sizing the product.

As consumption has increased, and it has become necessary to mine thinner and dirtier veins, a higher percentage of ash-bearing material finds it way into the coal which pours in continuous stream over the tipple. Mechanical production also adds to the undesired increment in that it precludes any substantial hand-cleaning by human element.

The first advance in preparation was the installation of picking tables, where all the coal in rapid agitation must pass in review before lines of men and boys whose duty lay in removing the obviously large pieces of slate or rock as they went by. This method, helpful as it was, left all the small pieces as well as the impurities in the slack coal, to add to the non-combustible content.

To overcome this difficulty, the attention of the leading coal producers of the United States has been directed for many years toward processes, both wet and dry, which at minimum cost and high efficiency, would yield a product of minimum ash. Not only is this desirable from a purely commercial or sales standpoint, but also as an economy due the purchaser, since freight paid on non-combustible material is a specific charge against the net B. t. u. delivered at the fire box, and is likewise measured in human or mechanical removal of ash, and lower evaporation of water per pound of coal.

In preceding issues of THE MINING CONGRESS JOURNAL the air cleaning process has been described. This method has carried special appeal to operators whose plants are subject to the rigors of northern winters or whose product in transit to destination in the North gave probability of freezing in the cars, where coal freshly loaded from wet cleaning processes become solidly frozen.

In the present issue will be found the latest advances in laundering coal by the sand flotation process, and the Rheolaveur method. By the former of these processes, it is estimated that in excess of ten million tons of coal are cleaned annually without the use of harmful chemicals or expensive solutions, and with marked increase in percentage of prepared sizes. The sand flotation method has been applied to both anthracite and bituminous coals.

The Rheolaveur installation described in this issue has been successfully applied under conditions considered among the most difficult in America. Not only does the coal readily disintegrate, but the rock impurities are also very friable, and form a colloidal mixture in the presence of water.

The successful application of laundering methods under the widely varying conditions described, is a tribute to the research engineers of the present day.

As the exigencies of commercial competition, and the demands of modern efficiency become greater and more exacting, the coal industry will find always at its disposal, a process or a specific equipment adapted to its individual needs, with the constant aim of improved preparation both in sizing and purity.

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**SENTINELS OF THE REPUBLIC**

THE CAPTION is the name of a new organization which proposes to hold meetings at various commercial centers in a "determined drive against Federal Bureaucracy, communism and the tendency of the Federal Government to encroach on the states, and on individual rights."

The official board is made up of a number of highly respected and nationally known individuals who probably have given little thought to the incongruity of the purposes linked together to make up its program.

We find it difficult at the same time to oppose Bureaucracy, which is a form of intensified government, and communism, the enemy of all government. This mixing of opposites indicates a looseness of thinking, as applied to the subject matter, which, as the basis of a widespread movement, seems a little dangerous. The term Bureaucracy has been used with derision by so many people that an analysis of its real meaning as a function of our Government seems to be justified.

A federal bureau is an administrative agency of Government, established by Congress to perform certain functions more or less clearly defined by congressional act. It is, at all times, subject to control by the administration and it can not survive except through the appropriation made by Congress for its maintenance. It is, therefore, subject to a double check and if it fails in its duties or if it undertakes any service outside its original functions, there is at all times a higher authority which can curb or put an end to all or any part of its activities. Again, the bureau is a continuing agency which carries out its specified work, year after year, so long as the particular service is required or seems to be required. It is supplied with equipment with which to carry on investigations and to perform functions which call for continuous operation. Its personnel is made up of scientists and specialists who by years of experience and special training are best fitted to do the particular work in hand. It is through these bureaus that Government performs the greater part of its service.

A Government department is an executive agency to supervise and direct the various bureaus which are assembled under its control. The department head is chosen by the President "by and with the advice and consent of the Senate." Bureau heads are at all times subject to removal by the President and the appropriations for their support are always under control of the public through congressional action.

While agreeing with some critics as to abuses of authority we still insist that this is necessarily a Government of bureaus; that our Government could not function except through these agencies.

The "Sentinels of the Republic" and all other Bureaupobists would better devote themselves to the destruction of communism, to the creation of a more distinct dividing line between the function of Government and the conduct of business enterprises and by a drive against the abuses which, without attention, naturally grow out of power without responsibility, rather than against a system which is the effective part and a necessary part of representative government.

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**TAX REFUNDS**

THE ATTEMPT of Senator McKellar, Senator Couzens, and others to set up a new governmental agency for the review of refund claims, by giving authority to the Comptroller General of the United States to review claims involving in excess of $50,000, will not be received with favor by taxpayers who already are harrassed and handicapped by the long delays, innumerable conferences and repeated audits and reviews now involved in the settlement of tax liability and settlement of refund claims.

The McKellar amendment to the deficiency appropriation bill, provided that no part of the $175,000,000 appropriated for the refund of taxes illegally collected shall be used to pay any claim in excess of $50,000 until such claim has been approved by the Comptroller General of the United States in accordance with existing law.

Under the existing law, it is expressly provided in Section 1107 that no decision of the Commissioner of Internal Revenue shall be reviewed on its merits by any other accounting officer, official, agent, or employe of the Government. That bars consideration of the merits of any tax case by the Comptroller General. At least, it was written into the law for that purpose. Under existing procedure, claims for refund are passed upon and reviewed by at least five separate individuals or agencies in the administrative organization of the Bureau, and claims in excess of $50,000 are reviewed by the General Counsel before going to the Commissioner for approval. It appears, therefore, that every possible check necessary to safeguard the interests of the Government is provided for under the existing system, and that the creation of a new reviewing body, involving a duplication of the existing administrative organization, is wholly unnecessary.

The amendment was deadlocked in the conference committee. The House voted three times, almost unanimously each time, to insist upon its rejection. It was so unnecessary, unjust, and would have entailed so much delay, expense, confusion, and perhaps controversy between the two administrative branches of the Treasury, that the conferees on the committee finally agreed to strike it out. It is such tampering with the income tax law and the administrative procedure under it, by overzealous lawmakers, that precludes the simplification and improvement of the Federal income tax system and prolongs the taxpayers' nightmare.

## COMING EVENTS CAST THEIR SHADOW

THE AMERICAN MINING CONGRESS has been responsible for the staging of twelve expositions of mining equipment. Most of them have been successful. Originally these expositions were held in conjunction with the annual conventions of the organization, and attempted to serve the entire mining industry with displays of equipment designed for every branch of it.

In 1921 a small group of manufacturers presented to the organization the idea of creating a Manufacturers Division. Early in 1922 this division became a reality, and the first exposition under its sponsorship was at Cincinnati, Ohio, in 1924.

Since that date the division has sponsored three expositions, each a greater success than its predecessor. These expositions have been held annually for the past three years, at Cincinnati, Ohio, in conjunction with an annual convention devoted exclusively to discussion of practical operating problems, directly under the auspices of The American Mining Congress, which is the sponsor body for both the exposition and convention. The fact that these events have been specialized—confined to the coal mining industry, and held in the center of the coal producing districts—has contributed materially to their success. Each year has seen interest mounting both in the mining machinery and coal producing industries, until this event has become synonymous with progress in coal production. The division has grown from the original few to a membership of thirty-eight of the leading mining machinery manufacturers, and the number of operating men attending the convention has increased steadily.

Perhaps the most significant thing concerning the Fourth Annual Convention of Practical Coal Operating Men, and the National Exposition of Coal Mine Equipment, to be held at Cincinnati, Ohio, during the week of May 16, is that fact that three months prior to the opening of the exposition, more than 90 percent of the total available space has been contracted for. And this is more significant when it is known that the convention management has increased this available space over last year by 40 percent.

While the sale of space is the barometer indicating the success of the exposition, the Program Committee for the convention held in conjunction with the exposition, is the most important factor in the success of both the convention and exposition.

Little is left to be desired concerning the Program Committee. It is in every sense a great committee. It is headed by Ezra Van Horn, a man whose leadership is recognized. He is backed up with splendid representation from every coal producing district in the United States. In addition he has the hearty cooperation of the great coal mining associations.

As the result of a nation wide vote, the committee found an overwhelming demand for thorough discussion of coal preparation, and mechanical loading. Six of the eight sessions of the convention will be devoted to discussion of the various phases of these problems. The remaining two sessions will be devoted to Safety, and Cutting and Blasting.

With a program arranged that is of intense interest, and an exposition staged which is a liberal education in itself, 1927 and Cincinnati will live up to the expectation of all those responsible for it, and set a new standard for events of this character.

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## THE KEY TO WORLD TRADE

WITH OUR foreign trade constantly increasing and particularly our imports, it is difficult to fathom the logic of those who insist that our protective tariff policy must be abolished in order to make it possible for our foreign creditors to be able to settle their obligations.

Statistics show that our imports in 1926 were four percent higher than in 1925 and forty-two percent higher than in 1922. Foreign countries sold in the United States during the year 1926 goods valued at $4,431,000,000, in spite of the tariff wall which is said by its enemies to be practicably prohibitive.

The comparison so frequently drawn between the tariff laws of the United States and the tariffs of the several European countries has little of basis. If the United States were to establish tariff walls as between the states and if these tariffs were "for revenue only" the comparison would be fairly made. A lack of either of these conditions destroys the comparison. Such lack also destroys the foundation of most of the recent nonchalant assurances by would-be economists that that governmental policy under which the United States has grown to be the foremost industrial nation of the world is, of course, to be abandoned because the fact that the United States has become the great creditor nation of the world has so changed conditions as make necessary a radical change in the policy which has made us great. In other words having ascended great heights we should immediately descend in order to enable our creditors to pay their obligations more easily.

Another line of assault has recently developed, viz: that in order to induce foreign countries to admit our exports free of duty we must provide reciprocal conditions. Col. Leonard P. Ayers, formerly technical adviser of the Dawes Commission, in a recent interview in Colliers Magazine predicts a

> "Revival of the tariff as a major political issue, with manufacturers leading in the demand for downward revisions.
>
> "American statesmen must open the channels of trade for our argosies. Today great areas of the world are closed to us by tariff walls just as this country has been closed to the world by our tariff walls. How are we to scale these barriers or at least penetrate them? Apparently there is only one way. Our own tariff system is perhaps the key with which we shall unlock these closed gates."

We must insist that the Colonel's answer to his own question "How are we to scale these barriers?" is not sound. Mass production made possible by a protected domestic market which absorbs eighty percent of production makes possible a low cost price which opens the only door to markets either foreign or domestic.

# MARK W. POTTER ON THE BITUMINOUS COAL INDUSTRY

***Comments Upon A Recent Article By Mr. Potter, Wherein He Contends That All Of The So-called Problems Of The Bituminous Coal Industry May Be Solved By A Mere Stroke Of The Pen***

*By* J. F. CALLBREATH *

MR. MARK W. POTTER in a recent communication to the Manufacturers Record expresses his belief that "*All of the so-called problems of the bituminous coal industry can be solved, all deserving interests can be served and consumers can be saved hundreds of millions of dollars a year almost by the stroke of a pen.*"

Such a statement from a man of Mr. Potter's vast experience and recognized ability can not fail to command public attention.

This statement is of particular interest at a time when the operators and miners of the central competitive field are engaged in a struggle to find a solution of the problem as to whether the coal operators in the four states may pay a satisfactory wage and earn a fair profit or whether most of the mines in that field shall close down more or less permanently and the enormous capital invested in these operations shall be practically annihilated and whether the miners in that field shall be permanently without work.

Surely if Mr. Potter's proposed solution would be effective it is entitled to most serious consideration. We quote from Mr. Potter's article:

"It is strange how easy it is to miss the real point of a situation and have our vision obscured by the dust of complexity, which might easily be avoided.

"Car distribution sounds like a technical subject and is assumed to be a difficult one. A far smaller task is to grasp the proposition that shippers have the right to buy what and where they please and to have the railroads furnish cars to haul what the shippers want, free from any right of the carriers to say what and where one shall buy or with whom he shall deal. This proposition is absolutely all there is to the so-called car-distribution problem. There need to be no complexity. The situation is perfectly simple and easy to understand by anyone who wants to understand it and is willing to give it thought."

Mr. Potter then lays down 14 separate propositions all of which are reasonable and most of which will meet general acceptance and continues:

"A recognition and application of these propositions, the soundness of which can not be questioned, permitting buyers to buy where and what they please and have the cars to haul the coal they want, would solve the coal problem for all time. All of the existing troubles are due to the fact that buyers are not permitted to buy where and what they desire. An antiquated statute, enacted to meet conditions that no longer exist, says that the mines shall control the use of cars, which means that the mines shall say where the consumers of coal shall buy if they want transportation. This results from the fact that while there are ample cars in the country to move all coal desired when those cars are properly used, there are no surplus cars. Therefore, under the present system, which gives the mines the right to say where the cars shall be used, buyers must follow the cars and go to the mines that control the cars and buy coal from them, whether it be good, bad or indifferent.

"The vice of the statute has been made effective by the action of the Interstate Commerce Commission in ruling that because the statute requires a distribution of the cars in recognition of the right of the mine, that distribution may be made on the basis of mine capacity, irrespective of coal quality, or of consumer's desire to buy or miner's ability to sell in competition and on merit. The commission might, under the statute, have corrected the evil by saying that a mine's right to cars shall be determined by the mine's ability to sell in competition and by the desire of the consumer to patronize a particular mine. The Commission, having thus applied the statute, the statute should be repealed or amended along the lines of simplification to recognize the consumer's rights. The railroads are buying more and more cars; and more and more mines, which make bad matters worse, are being opened, when present cars in present mines are more than ample, and the consumers have to pay the bills. All of the ills result from a flagrant and brutal violation of the simple, firmly established, fundamental American right to do business with whom one pleases, which no one has the temerity to challenge. Consumers are being exploited by a shocking and outrageous degree of selfishness and waste, which would not be tolerated if it were not easy, under a wrong interpretation of the law, to pass the burden on to consumers. All of the so-called problems of the bituminous coal industry can be solved, all deserving interests can be served and consumers can be saved hundreds of millions of dollars a year almost by the stroke of a pen.

"It is an interesting phase that the miners in the central competitive field, in forcing the Jacksonville agreement, really saved the consumers of the country and brought about the recent low prices of coal by making demands so high as to close many mines and bring about concentration at others. Thereby they brought about continuous operation at fortunate mines producing good coal, which they could not control, and the efficient use of cars. It was a hard thing for both the mines and miners in the central competitive field, and the carriers that serve them, but a public service to consumers was rendered.

"The country may enjoy the good luck of having the miners in the central competitive field again make demands at the expiration of the present agreement for a wage scale so high as to continue the present condition of relative non-operation, thereby continuing the present condition of concentration, by which desirable mines may have the benefit of continuous operation and railway cars may be used efficiently in serving a limited number of mines."

We call particular attention to the first and last paragraphs quoted. Can it be that Mr. Potter has "missed the real point" or does he believe that the coal business of the four states of Indiana, Illinois, Ohio and western Pennsylvania should be permanently sacrificed and that by a "stroke of the pen" the property rights not only of the operators in the central competitive field but of the owners of all surplus mines in other fields which have not yet been developed to the point of highest efficiency shall be confiscated? And is it certain that the exercise of the right of consumers to buy coal where and of whom they please would furnish any solution of the present problems?

We are quite certain that in the central field there has been an abundance of idle cars at all times during the past three years and we have heard no complaint of car shortages in the southern field. We believe that every consumer in the United States has been able, at all times during the recent past, to exercise his right to buy when and from whom he pleased and without any consideration of the problem of car distribution. But the coal problem still persists. And it is not confined to the central competitive field.

At this particular time a number of southern railroads are buying coal for storage at prices ranging from $1.15 to $1.25 per ton when the cost of production averages $1.67 per ton.

THE MINING CONGRESS JOURNAL believes that the bituminous coal problem can be settled, not by the stroke of a pen, nor by any plan which means ruin to a large minority but by the cooperation of all owners of commercially possible production upon a basis which recognizes all values, present and remote and the fact that all coal for this and future generations is now in existence and available for immediate production.

* Secretary, The American Mining Congress.

*Mt. Shasta from a Siskiyou County Lake, California*

# FEDERAL DOMINATION VS. STATE SOVEREIGNTY

***California As Example Of One Of Eleven Victims Of A Public-Land Policy Which The Writer Asserts Is No Improvement Over Feudal Law, Shows That One-fifth Of Entire Area Is Exempt From State Taxation, While She Is Expected To Protect And Improve This Territory***

*By* CHAS. L. GILMORE *

THE establishment of forest reserves in the Western States dates from 1891, as already shown, but it was many years before any real effort was made to extend the system of national forests to the Eastern States. In the East, Congress had followed the Constitution and disposed of the land, while in the West it violated the Constitution and refused to dispose of it. But on March 1, 1911, the bill providing for the *purchase* of lands in the Eastern States for forest reserves received presidential approval. The measure was and is totally unnecessary and inoperative for any real purpose. It was adopted for the sole purpose of counteracting the growing resentment in the West toward the land withdrawal policy of Congress.

The fixed policy of Congress of disregarding the Constitution in refusing to dispose of the public lands has created a grave economic problem in many parts of the Western States. In California alone there are more than 19,000,000 acres of Government owned national forest land. It is included in 39 counties. Some of the counties have as high as 80 percent of their total land areas withheld as national forest land. Yet those counties must aid in policing the forests through their constables, sheriffs and other peace officers who are paid wholly by the county; they must, and do, maintain and operate courts for the prosecution of offenses occurring within national forests; they must and do establish, maintain and operate public schools within the forests; they must and do construct and maintain roads, bridges and trails within the forests, and they must and do in every way protect life and property within those forests just as effectively and to just the same extent as is done on lands in private ownership wherever they may be situated in the county.

The area of public lands within national forests in California equals the combined areas of the States of New Hampshire, Vermont, Massachusetts and Delaware. The United States Bureau of Public Roads has set a value of $146,599,866 on the grazing and timber therein. The California Forest Protective Association, working with the Federal Forest Service, has set a value of

* Attorney at law, Sacramento, Calif.

$300,000,000 on the combined resources of the Government owned national forest lands in California. While there is apparent discrepancy between the two sums, they are not in any manner representative of the true value when we consider the billions of feet of standing timber worth on an average of $2.50 per thousand feet at the stump.

### Income to State and County

The 19,000,000 acres of Government owned national forest land in California are not taxed in any manner for the support or maintenance of state, county or local government. The only remuneration the several counties receive from that immense domain that is immune from the assessor and tax collector is 25 percent of the amount received by the Federal Government from timber sales, grazing fees, etc. The Forest Service expends directly 10 percent of the total receipts in road and trail construction within the national forests. The state receives not one penny.

In actual dollars and cents the income to the counties is a mere pittance. By way of illustration, we may take the income of the Forest Service for the year 1924 from all national forest sources in California. That was a banner year for the Forest Service, and the illustration will be apt because of the extraordinary income received. The total receipts from all sources in California that year were $1,241,605, or about $1 for each 15 acres. The 39 forest counties received as their total portion the sum of $310,400. This equals $1 for each 60 acres of land. In other words, the counties received 2 mills for each dollar of valuation as set by the United States Bureau of Public Roads, or 1 1/3 mills per dollar of valuation as set by the California Forest Protective Association and the Forest Service.

The fiscal year ending June 30, 1925, represents an average year of Forest Service income. The total income from all national forest sources in California that year was $986,646, or approximately $1 for each 19 acres. The forest counties of California received the sum of $246,661, or about $1 for each 76 acres. The actual return on the valuation set by the Bureau of Public roads was 1 6/10 cents on each $100. Using the valuation of the Forest Service, the income figures out eight-tenths of 1 cent on each $100. We will quote another year for illustration.

The fiscal year ending June 30, 1926, represents the period of the largest annual revenue of the national forests in California since their establishment. Total income from all sources in this state was $1,276,245, or approximately $1 for each 15 acres of land. The 39 forest counties received as their share $319,060, or about $1 for each 60 acres of land. Using the valuation of the Bureau of Public Roads, the return was approximately 2 mills, and on the Forest Service valuation the return was approximately 1 6/100 mills on the dollar.

Thus you will note that the forest counties of California receive an average annual income of about 1½ cents on each $100 of valuation from the Federal Government through the Forest Service.

### Why State Aid?

The Federal Government, with these millions of acres of fine timber, can not administer it save at a loss, although it has had more than 35 years to demonstrate its efficiency. It continually importunes and begs the State of California to appropriate money out of the state treasury to protect those forests. Why California should be called upon to further impoverish itself in the interests of an absentee landlord is incomprehensible.

*This is the third article in Mr. Gilmore's series upon the public lands question. In it he relates the situation California finds herself in because of our public-land policy. 19,000,000 acres or one-fifth of her entire area, because of this policy, is exempted from state revenue and control, a situation which applies in principle to her ten sister public-land states.—The Editors.*

The Federal forestry officials tell us that the loss in taxable income to the state and counties is more than offset by the improvement work in road and trail construction carried on by the Forest Service and in the gain in taxable property through logging and milling operations carried on in the national forests through sales of standing timber.

As to the first contention, it is fallacious in its entirety. Out of the above quoted total receipts from all national forest sources in California, the Forest Service sets aside 10 percent for road and trail construction and other improvement work in the forests. For 1924 this amounted to $124,160; for 1925, $98,664.60; and for 1926, $127,624.50. The power companies alone in California have spent more money in road construction of a permanent, public character during the past 10 years than the Forest Service has spent as a sum total since its inception in 1891. When speaking of road construction and to compare the Forest Service expenditures with the road bill of California, bear in mind that California spends in excess of $20,000,000 annually in road construction and repair. And do not forget that the national forests cover one-fifth the total land area of the state.

As to the second contention, it is even less tenable than the first. Take the total income of the Forest Service from timber sales in California for the year 1924. It amounted to $910,970. Take the average selling price of $2.50 per thousand feet, which is a very low rate, and the resultant board feet will represent just one season's run for any of the dozen or more lumbering concerns in this state. If the total were divided between 39 counties, it wouldn't do any more than irritate the assessors and tax collectors.

### What Is Your Tax Rate?

There may exist state and county governments that can continue their functions with a tax rate of 1½ cents on each $100 of valuation, but if such there be they have escaped my notice entirely. But the great and powerful Government of the United States of America, through its Forest Service enthroned at Washington, says that such a return is ample to the people of the sovereign State of California. To violate the original agreement between the sovereign states and do violence to every principle of that Constitution that enables the National Government to exist may be a perfectly sound and legal principle; but to impoverish portions of 11 states of this Union under the guise of conservation is a crime. To say that they can carry on and discharge the functions of government with an income of 1½ cents on each $100 of valuation of their property is carrying propaganda beyond all limits of reason and sense.

### Equalize the Burden

If these 186,000,000 acres of Government owned national forest lands in the 11 Western States belong as much to the denizen of New York City as to the citizen of one of California's forest counties, then would it not be fair and just to require the New Yorker to pay directly as remuneration to those unfortunate forested counties what the citizens of those areas are forced to pay indirectly?

If these forested areas are to be withheld from the disposal plan of the Constitution as playgrounds for the peoples of the whole United States, and as the reservoir of the timber supply of the future generations of all peoples, then wouldn't it be an eminently fair thing for the United States of America, as the sovereign proprietor of this barony, to make some actual, tangible effort toward reimbursing those states and counties who are in the helpless predicament of holding the empty sack?

When the United States of America refuses to follow the plain dictates of the Constitution by refusing to dispose of the land, and becomes a landed proprietor the same as any individual landowner, why should it refuse to submit its lands to taxation? Its subjects must submit to taxation, and why not the sovereign, when the object held is not an es-

sential of government nor any function of government under our form.

The same subject agitated the people of Pennsylvania in its early history. The "Crown lands," or the lands of the Penn family, were exempt from local taxation the same as our Government owned national forests are now. The citizens of that colony even went so far in their efforts toward bringing these sovereign lands under the jurisdiction of the tax collector as to send Benjamin Franklin to England in 1757. The people of the colony of Pennsylvania desired rather to be an appanage of the crown, than a fief of the Penns. At the present writing, there are 11 states in the Union that occupy positions with respect to large areas of tax-exempt lands within their borders exactly analogous to that of Pennsylvania when Franklin went to England in 1757.

### Taxing Government Lands

The argument has been advanced that it would be an unprecedented step for the United States Government to consent to pay and actually pay local taxes precisely as an individual landowner. It has been stated that such legislation would be unconstitutional. Both premises are erroneous. The act of Congress, approved June 9, 1916, provided for the payment of delinquent taxes on the forfeited Oregon and California Railroad Co.'s land grant in Oregon and Washington, and the act of Congress, approved February 26, 1919, made similar provision as to lands within the forfeiture of the Coos Bay Wagon Road grant in Oregon. At the last session of Congress another act was passed and approved by the President providing for payment of delinquent taxes on additional forfeited lands in Oregon. The right of Congress to allow the several states to tax Government property was judicially determined by a legal proceeding by the Supreme Court in State of Nevada *vs.* Central Pacific Railway Co., reported in volume 162 of United States Reports at page 512.

And why should not the Federal Government pay taxes on these vast areas? Neither the Federal Government nor the Forest Service created those areas. Acres and acres of those woods were covered with saplings hundreds of years ago and were magnificent pillars of the forest when Genghis Khan completed his mighty kingdom from the Volga to the Pacific and from Siberia to the Persian Gulf. If they are the property of anyone, they belong wholly, totally and absolutely to the sovereign states wherein they are situated. The United States has forfeited whatever right it had in and to those areas by violating the original contract between the states and under which the United States came into being.

### Expenditures vs. Taxing Power

It has been said that the Federal Government has earned the right to withhold these forest areas from sale and disposal because of its appropriations to those states in aid of local improvement, such as improvements of waterways and public roads. The Federal Government does not differentiate between forested states and non-forested states in appropriating money for public work. It improves rivers and harbors because it has exclusive jurisdiction over interstate commerce. The same rule applies to public roads. However, I venture the statement that if the Federal Government will reimburse the several counties in the 11 forested states for the lands included in national forests and other forms of withdrawals on the same basis as the tax rate levied on privately owned lands similarly situated, Congress can cease making appropriations to those states for any purpose.

### Add Another Star

Thus there is in existence within 11 states another state, separate and distinct from the state government. The local laws relating to the taxing power do not apply, yet the right to levy and collect taxes has always been considered the first fundamental right of sovereignty. The government of these forested areas, as well as the areas of other withdrawn lands, is not related to the government of the states wherein they are situated. There is practically a complete code of laws for them separate and distinct from the state's statutes. A regiment of clerks in Washington does practically nothing else but create laws, termed "regulations," for the government of those areas.

Far back in the pages of history we learn that other peoples were burdened with forests of the sovereign wherein a separate and distinct government was maintained. King John at Runnymede was forced, on that memorable June morning in the year 1215, to repeal his obnoxious forest laws and agree to set aside the forests created by royal proclamation. And he did this in the following language of the forty-seventh paragraph of Magna Charta:

"All forests, constituted as such in our time, shall straightway be annulled."

But that was England in 1215, and this is the free Republic of the United States of America in 1927. We grant the sovereign here the right to make forests at will by royal proclamation and to create other Federal areas by the same means. We further grant the sovereign the right to make such laws for the government of those forests as in its own discretion shall seem fit, together with the right to change the laws to please its own whim, and all without reference in any manner to the general legislative authority of the nation. And finally, we grant the sovereign the royal prerogative of exemption from all forms of taxation.

### Sovereignty and Taxation

The right to tax property being the first prerequisite of sovereignty, it must be conceded without argument that there are 37 states in the Union that are sovereign and 11 that are not. If the Central or Federal Government has the unqualified right under our Constitution to deny a sovereign state the right to tax property within the latter's borders, and the unqualified right to designate taxable and non-taxable property, all without the consent of the legislatures of the states affected, then the Federal Government has the unqualified right to impose its own taxing power on any state as well as its own methods of taxation on anything or anybody within that state, whether or not the subject matter is related to interstate commerce and to the total exclusion of the right of the state to levy or collect taxes for any purpose. Thus, if the present system in vogue in the 11 forested states is a constitutional exercise of the power of taxation of the Federal Government, then the Federal Government has the unquestioned right to set wholly at naught the taxing power of any state and each political subdivision thereof and establish its own exclusive system therein.

As a legal premise, taxation without representation and prohibition of the right of taxation are synonymous. There may exist a distinction, but there is no difference. Each is opposed to any individual sovereignty of the individual state and each partakes of the relation of lord and villein. The latter, under feudal law, had no rights against their respective lords except, perhaps, of protection from bodily harm, and they were subject to removal from their lands at the will of the lord. Such a feudalistic theory certainly has no place in a republican form of government. But we are returning to that theory and form of government when we centralize all power in a bureaucracy that can not be changed nor modified by any vote of the people.

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Fenton H. Finn, of Ridgway, Pa., a junior in the Department of Mining and Metallurgical Engineering at the Carnegie Institute of Technology, has been awarded the national scholarship of $500.00 offered annually by the American Institute of Mining and Metallurgical Engineers, according to an announcement. The scholarship is effective during the current college year. Finn is the first Carnegie student to win the honor. All students of mining, metallurgy or geology throughout the country are eligible to compete for the award. Funds for the scholarship are provided by the Women's Auxiliary to the Institute.

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*The headquarters of the great Smithsonian Institution, founded in 1846, in Washington, D. C.*

# LEGISLATIVE REVIEW

***Congress Session Ends—Important Legislation Passed During Closing Days But Many Bills Fail Of Approval—Bills Unacted On Go Over Until The December Session Or Extra Session—Mining Bills Occupy Attention Of Congress Up To The Close Of The Session***

BY THE time this issue of the JOURNAL reaches our readers the Sixty-ninth Congress will have come to a close. By constitutional limitation, the work of Congress closes on March 4 in years of uneven date. Unless an extra session is called, the first session of the Seventieth Congress will not convene until December 3. As the President is generally opposed to extra sessions, he is not likely to call one unless a serious situation should develop in domestic or international affairs. In the domestic field the only situation which might demand the reconvening of Congress would be caused by a strike of coal miners. Representatives of bituminous operators and miners are now meeting at Miami, Fla., on a new wage agreement effective April 1, when the present contract expires. At this writing Congress had not acted on legislation to meet an emergency in the coal situation, although two attempts were made in the House Committee on Interstate Commerce to provide authority for the President to appoint special mediation boards, and a fuel distributor, and to authorize the Interstate Commerce Commission to distribute coal under priority orders. As to foreign relations, conditions have improved in connection with the Mexican situation arising over the application of the new laws of that country requiring concessions to oil lands, and an extra session is not looked for on this account.

As this review of Congress is being written in advance of adjournment March 4, it is impossible to give the exact final status of important legislative proposals effecting mining, as some of them are slated for consideration or are being pressed for action before March 4. But with the remaining short time before the close of Congress and the pressure for action on a large number of measures, it is safe to predict a number of proposals will fail of enactment. In this event they will have to be reintroduced when Congress reconvenes and go through the same legislative stages in order to receive further consideration.

Up to the last minute friends of the Muscle Shoals and Colorado River development bills were hopeful of action on their measures, but the outlook was not promising. Anticipating no action on these proposals, substitute propositions were advanced for further investigation of the Colorado River project and for temporary Government operation of the Muscle Shoals project.

Strong efforts were being made to have the House act on bills already passed by the Senate authorizing adjustment of losses of war mineral producers for interest on borrowed capital and purchase of property, and with the right of appeal to the Court of Claims, and also requiring the Government to purchase approximately 15,000,000 ounces of silver at $1 per ounce to complete transactions under the Pittman Silver Act passed during the war. Increased appropriations were sought for the Bureau of Mines for investigations of economics of the mineral industries, geophysical methods of prospecting and accident prevention. These additional funds were approved by the Senate Committee on Mines and Mining, and attempt was made to make them available during the year beginning July 1 in the final deficiency bill to be passed by Congress. Further experimentation on the mining and extraction of oil from oil shale by the Bureau of Mines at its plant in Colorado and additional funds for investigations by the bureau on processes for production of iron and steel from domestic manganese ores were recommended by the Budget Bureau.

Bills suggested by the Interior Department to authorize patents to 640 acres of land containing copper and other deposits requiring deep mining without the applicant showing an actual mineral discovery were laid aside by the House Committee on Public Lands because of opposition based on the fact that it would be unfair to other mineral prospectors who are required by the mining laws to develop a mineral before patent will issue.

It seems possible that Congress would amend the law authorizing potash explorations by the Interior and Commerce Departments so as to relieve landowners from drilling costs if potash is not found on their lands. Bills to this effect were favorably reported by both Senate and House committees having jurisdiction of the matter. The President approved a law of Congress authorizing potash prospecting permits and leases on public lands.

The legality of the transfer of the Bureau of Mines from the Interior to the Commerce Department was questioned by Senator Walsh, Democrat, Montana, who prevented action by the Senate on a bill already passed by the House amending the helium conservation act by transferring jurisdiction thereunder from the Interior to the Commerce Department. This bill was made necessary because the Bureau of Mines was attached to the Interior Department when the helium act was passed two years ago.

A bill was passed by the Senate and is pending in the House authorizing oil and gas mining leases on unallotted lands in Executive order Indian reservations.

Congress took an important step in restoring public lands to the states, which are now held by the Government, when it passed and the President approved a law giving title to the states to the minerals in their school-land grants. The law requires the states to lease the minerals.

Bills were introduced, but too late for action, requiring the marking of platinum imported into the country or transported in interstate commerce, so as to certify as to the weight, quality, fineness and quantity of platinum.

The Senate passed a resolution favoring arbitration of the dispute between this country and Mexico over the laws of Mexico requiring concessions to mineral lands, but up to date the Government has taken no steps to treat with Mexico on the situation. In response to a Senate resolution, the State Department advised Congress that companies controlling 90 percent of oil lands and producing 70 percent of the oil output of Mexico had declined to comply with the new law. It was reported that Mexico is sending an official to this country to confer with oil interests regarding the situation.

Despite strong attempts in both House and Senate to pass tax bills, the administration was able to defer tax revision legislation until the next session of Congress. A resolution designed to revise the tax laws at this session was amended so as to apply the Treasury surplus to a reduction of the public debt. The House Committee on Ways and Means plans to consider tax revision beginning next October, with a view of recommending a new tax law at the December session. It will be aided in its work by investigations which are now being conducted by the Joint Congressional Tax Revision Commission representing the House and Senate. Review by the Comptroller General of tax refunds granted by the Internal Revenue Bureau for $50,000 or

more was proposed on the deficiency bill, but action has not been finally taken as this article is being written. Another proposal that the Board of Tax Appeals pass on refunds of $10,000 or more was embodied in a bill, but was not acted on by the Senate Finance Committee. Attempts in the House and Senate to reduce corporation taxes also failed, the administration contending that the 1926 law should be allowed to stand unamended for a reasonable length of time in order to determine the extent of further permanent tax revision. A new tax proposal was advanced in the House as a cure for war, in the form of a measure to impose a tax of 1 percent on all property and in addition income taxes of from 5 percent on $1,000 incomes up to 75 percent on incomes of more than $500,000.

Bills to require the use of American products on public contracts and compliance by Government contractors with state laws on labor and wages were introduced. The Senate Committee on Labor reported a bill previously passed by the House establishing a safety division and museum in the Department of Labor.

An investigation by a congressional commission of possible amendments to the immigration law was proposed in a House bill. Another legislative proposal appeared in the Senate, which would require district courts to decide cases within four months after they are submitted, and circuit courts of appeals to decide cases within six months after their submission.

### Fuel Control

H. R. 16972. Introduced by Mr. Parker (Rep., N. Y.). Laid on the table by the Committee on Interstate Commerce. This bill proposed to regulate the distribution of fuel during emergencies through a Federal fuel administrator and the Interstate Commerce Commission.

### War Minerals

S. 3641. Reported by the House Committee on Mines and Mining. This bill, already passed by the Senate, amends the War Mineral Relief Act by authorizing adjustment of leases on account of interest on borrowed capital and purchase of property, and for appeals to the Court of Claims. The bill provides:

"That so much of section 5 of the act entitled 'An act to provide relief in cases of contracts connected with the prosecution of the war, and for other purposes,' approved March 2, 1919, as amended, as reads 'that the decision of the said Secretary shall be final and conclusive, subject to the limitations hereinafter provided,' and so much of said section 5 as reads 'that nothing in this section shall be construed to confer jurisdiction upon any court to entertain a suit against the United States,' are hereby repealed.

"That section 2 of the said act is hereby made applicable to claims filed under section 5 of the said act in the same manner and in all respects similar to the application of said section 2 to section 1 of the said act: *Provided, however*, That in cases where final decisions of the Secretary of the Interior have been heretofore rendered, said appeal to the Court of Claims shall be made within 90 days after the passage of this act; and in all cases where final decisions of the Secretary of the Interior have not heretofore been rendered, appeals from such decisions to the Court of Claims shall be made within 90 days after such decisions shall have been rendered by said Secretary: *And provided further*, That no acceptance or acquittance by any claimant of or for any settlement made heretofore by the said Secretary shall prevent or estop any appeal to the said Court of Claims as herein provided for: *And provided further*, That if and when any claimant shall desire to appeal from the judgment and decision of the Secretary of the Interior upon any claim upon which money has been paid to and received by such claimant upon his claim, then, before he shall have the right to appeal to the Court of Claims, and as a condition precedent to his taking the appeal, he shall enter into a good and sufficient bond, signed by himself and good and sufficient sureties and payable to the Secretary of the Interior, conditioned that, should the Court of Appeals find that more money had been paid to the said claimant upon his claim than he was entitled to receive thereon, said claimant will repay to the Secretary of the Interior for the use of the Government such sum of money as he shall have received upon his said claim in excess of the finding and judgment of the Court of Appeals.

"That section 5 of the act entitled 'An act to provide relief in cases of contracts connected with the prosecution of the war and for other purposes, approved March 2, 1919, as amended,' commonly referred to as the War Minerals Relief Act, is hereby amended to authorize and direct the Secretary of the Interior to determine, adjust, liquidate, and pay net losses resulting from moneys expended or obligations incurred for the purchase or lease of property acquired for the production of, or in the preparation to produce either manganese, chrome, pyrites, or tungsten, and also to determine, adjust, liquidate, and pay net losses arising from money paid or due to be paid for interest only on borrowed capital not to exceed the legal rate of interest in the state where the obligation was incurred: *Provided, however*, That the determinations, adjustments, liquidations, and payments of the net losses herein authorized and directed to be made shall be made by the Secretary of the Interior in conformity to and in compliance with, and not otherwise, all the provisions and regulations of said section 5 of the act approved March 2, 1919, as amended, the same as if the net losses herein authorized and directed to be determined, adjusted, liquidated, and paid had been originally incorporated and included in the net losses of said section 5, as amended: *And provided further*, That nothing herein contained shall be construed as permitting the consideration of any claim herein authorized unless such claim shall have been presented for determination, adjustment, liquidation, and payment under said section 5 of the act approved March 2, 1919, as amended, in compliance with the provisions and requirements of said section 5, as amended.

"No claim under this act shall be subject to review or adjustment under section 236 of the Revised Statutes as amended.

"That no agent, attorney, or other person engaged in preparing, presenting, or prosecuting any claim under the provisions of this act shall, directly or indirectly, contract for, demand, receive, or retain for such services a sum greater than 10 percent of such award. Any persons who shall violate any of the provisions of this section, or who shall wrongfully withhold from a claimant the whole or any part of an award, in excess of the sums due for services rendered, as set forth in this section, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall, for each and every such offense, be fined not exceeding $500 or be imprisoned not exceeding one year, or both, in the discretion of the court."

H. Res. 416. Introduced by Mr. Winter (Rep., Wyo.). Referred to the Committee on Rules. This resolution requested a special rule for consideration by the House of the foregoing bill.

### Copper Mining

S. 5438. Introduced by Mr. King (Dem., Utah). Referred to the Committee on Public Lands. This bill proposes to authorize patent to 640 acres of land containing gold, silver, cinnabar, lead, tin, copper or other valuable deposits, requiring deep mining, without the applicant showing an actual mineral discovery.

S. 5681. Introduced by Mr. Stanfield (Rep., Oreg.). Referred to the Committee on Public Lands. This bill is similar to the foregoing.

### Potash Exploration

S. 5034. Reported by the Senate Committee on Agriculture. This bill amends the potash exploration act of 1926 by removing the former requirement that landowners should bear the cost of drilling whether or not potash is discovered.

H. R. 15827. Reported by the House Committee on Mines and Mining. This bill amends the potash exploration act.

### Potash Leases

H. R. 5243. Enacted into law. This law authorizes prospecting permits and leases for potash on public lands.

### Oil Leases

S. 4893. Passed by the Senate. This bill authorizes oil and gas mining leases on unallotted lands in executive order Indian reservations.

H. R. 15021. Reported by the House Committee on Indian Affairs. This is similar to the foregoing.

### Mine Funds

S. 5329. Introduced by Mr. Oddie (Rep., Nev.). Reported by the Senate Committee on Mines and Mining. This bill proposed to appropriate the following sums for the Bureau of Mines for the year beginning July 1, in addition

to those recommended by the Budget Bureau: Mineral mining investigations, $25,000; economics of mineral industries, $40,000; operating mine rescue cars and stations, $55,500; investigating mine accidents, $35,000.

H. R. 16742. Introduced by Mr. Arentz (Rep., Nev.). Referred to the Committee on Mines and Mining. This is similar to the foregoing.

### Mineral Lands

S. 564. Enacted into law. This law grants to the states title to mineral lands in their school land grants, which have been heretofore withheld by the Government. The states are to lease the minerals. The law provides:

"That, subject to the provisions of subsections (a), (b), and (c) of this section, the several grants to the states of numbered sections in place for the support or in aid of common or public schools be, and they are hereby, extended to embrace numbered school sections mineral in character, unless land has been granted to and/or selected by and certified or approved, to any such state or states as indemnity or in lieu of any land so granted by numbered sections.

"(a) That the grant of numbered mineral sections under this act shall be of the same effect as prior grants for the numbered non-mineral sections, and titles to such numbered mineral sections shall vest in the states at the time and in the manner and be subject to all the rights of adverse parties recognized by existing law in the grants of numbered non-mineral sections.

"(b) That the additional grant made by this act is upon the express condition that all sales, grants, deeds, or patents for any of the lands so granted shall be subject to and contain a reservation to the state of all the coal and other minerals in the lands so sold, granted, deeded or patented, together with the right to prospect for, mine, and remove the same. The coal and other mineral deposits in such lands shall be subject to lease by the state as the state legislature may direct, the proceeds of rentals and royalties therefrom to be utilized for the support or in aid of the common or public schools: *Provided*, That any lands or minerals disposed of contrary to the provisions of this act shall be forfeited to the United States by appropriate proceedings instituted by the Attorney General for that purpose in the United States district court for the district in which the property or some part thereof is located.

"(c) That any lands included within the limits of existing reservations of or by the United States, or specifically reserved for waterpower purposes, or included in any pending suit or proceedings in the courts of the United States, or subject to or included in any valid application, claim, or right, initiated or held under any of the existing laws of the United States, unless or until such application, claim, or right is relinquished or canceled, and all lands in the Territory of Alaska, are excluded from the provisions of this act.

"That nothing herein contained is intended or shall be held or construed to increase, diminish, or affect the rights of states under grants other than for the support of common or public schools by numbered school sections in place, and this act shall not apply to indemnity or lieu sections or exchanges or the right hereafter to select indemnity for numbered school sections in place lost to the state under the provisions of this or other acts, and all existing laws governing such grants and indemnity or lieu selections and exchanges are hereby continued in full force and effect."

### Mine Development

S. 5031. Reported by the Senate Committee on Postoffices. This bill proposes a commission to develop an international highway from Canada to South America. It is said the highway will furnish transportation to 2,000 miles of country known to contain quartz ledges of amazing commercial values in gold and other metals, at present unworkable owing to the hardships of long river trips and jungles almost impossible for mining men to penetrate.

### Government Contracts

H. Con. Res. 51. Introduced by Mr. Wood (Rep., Ind.). Referred to the Committee on Interstate Commerce. This bill provides that American materials shall be used in performing Government construction contracts.

H. R. 15662. Passed by the House. This bill authorizes the War Department to secure the services of the Geological Survey in making topographic surveys for military purposes.

### Oil Arbitration

S. Res. 327. Passed by the Senate. This resolution proposed the arbitration of the disagreement of the United States with Mexico over the restrictive land and oil laws, based on the principle that the United States should protect the lives and property of its citizens in foreign countries. The resolution reads:

"That while by virtue of sovereignty, the duty devolves upon this Government to protect the lives and property of its nationals in foreign countries, which duty is not to be neglected or disregarded, it is nevertheless sound policy, consistent with the honor and best interest of the United States and promotive of international peace and good will, to submit to an arbitral tribunal, which shall apply the principles of international law, the controversies with Mexico relating to the alleged confiscation or impairment of the property of American citizens and corporations in Mexico; the arbitration agreement to provide for protection of all American property rights pending the final outcome of the arbitration.

"That in good will and friendliness efforts should be made and persisted in to effect arrangements which will commit the two governments to the policy of abiding by and executing awards that may be made in consequence of such arrangements to arbitrate."

S. Res. 352. Introduced by Mr. Borah (Rep., Idaho). Passed by the Senate. This resolution proposes to extend the time for the settlement of claims between the United States and Mexico. Under the present law, these claims must be settled by August 30, 1927.

S. Res. 330. Passed by the Senate. This resolution called on the State Department for information as to oil concessions and titles of Americans in Mexico based on rights acquired prior to May 1, 1917. The resolution called for the names of Americans owning or claiming oil rights or concessions in Mexico; those who have accepted the new laws of Mexico bearing on land rights, and those who have refused to accept the new regulations; whether the department advised Americans in connection with these laws, and correspondence between the department and Americans in connection with the concessions or mineral rights. The State Department submitted a report on the situation.

### Tax Revision

S. Res. 336. Introduced by Mr. Harrison (Dem., Miss.). This resolution declared that permanent tax legislation should be passed at this session of Congress. The Senate, however, voted as a substitute a resolution by Senator Norris (Rep., Nebr.), providing that the Treasury surplus should be applied to reduction of the public dept.

H. R. 16462. Amendment to by Mr. Harrison (Dem., Miss.). This amendment proposed to reduce the corporation tax to 11 percent for the calendar year 1927 and thereafter, but was ruled out of order on the appropriation bill to which offered.

S. 5540. Introduced by Mr. Sheppard (Dem., Tex.). Referred to the Committee on Finance. This bill would require the Board of Tax Appeals to pass on tax refunds of $10,000 or more.

H. R. 16910. Introduced by Mr. Green (Rep., Iowa). Reported by the Committee on Ways and Means. This bill proposes to authorize twelve special assistants to the Board of Tax Appeals at $7,500 a year.

H. R. 16462. Amendment to by Mr. Reed (Dem., Mo.). Rejected by the Senate. This amendment proposed a 10-percent refund on 1926 taxes paid in 1927.

### Property Tax

H. R. 16438. Introduced by Mr. Allgood (Dem., Ala.). Referred to the Committee on Ways and Means. This bill provides that upon declaration of war the President shall make a capital levy of 1 percent on all property, tangible and intangible, listed in every county, city and state for local taxes. In addition there would be annual income taxes ranging from 5 percent on $1,000 incomes up to 75 percent on incomes of more than $500,000. The purpose of the bill is to discourage war.

### Power Development

S. 5362. Re- (*Continued on page* 179)

# ASBESTOS AND ITS IMPORTANCE AS A NATIONAL ASSET

*Early History Records Its Use—Its Fibrous Crystallization A Mineralogical Phenomenon—Asbestos Is Absolutely Indispensable To Civilization—Road Building And Power Lines The Only Essential To Development In The United States*

*By* E. SCHAAF-REGELMAN *

WHILE the name asbestos is becoming more and more familiar to the average person, few, not belonging to the technical fraternity, have anything but a hazy conception of what this substance really is. To the average layman's mind the word asbestos suggests either a theater curtain, or a piece of pipe and boiler covering, or his automobile brakes, or a pretty roof he has seen, but, what the raw material looks like, the majority of people do not know and many care still less.

Yet asbestos is one of the most fascinating products of nature known, as it is a mineral which, however, in its fabricated state appears to be rather of a vegetable or animal origin on account of its fibrous structure and silk-like luster.

The knowledge of its peculiar qualities and its sporadic use, if not in arts and industries, at least as a curiosity, goes back to the dawn of history. At about Tut-ankh-Amen's time, so some of the historians would have us believe, mummies were wrapped in cloths made from asbestos; the eternal lamp in the temple of Pallas, Athene had an asbestos wick and later, at the time of Charlemagne, chroniclers of events mention a table cover made of asbestos, which the royal joker, in order to amuse his guests, threw after a meal in the fire for cleansing and restoring it to its original beauty.

Aside from occasional references during the subsequent thousand years, asbestos has not been considered worth while mentioning, except perhaps in mineralogical treatises, but in the beginning of the nineteenth century fairly large deposits were found in the Aosta valley of the Italian Alps and in the Ural Mountains of Russia. Canadian asbestos probably made its first public appearance at an exhibition in London in 1862.

As soon as the non-combustible properties of this mineral fibre, were recognized by authorities in applied mechanics, investigations into the nature and utility of this strange mineral were started by research engineers in several countries, and the vast importance of asbestos was soon demonstrated. This started a worldwide search for deposits, which was most fortunately well rewarded, by the finding of large supplies in nearly all continents.

Many a time the question has been asked: Why is asbestos fibrous? What makes it so? The best answer is perhaps to point out that certain minerals crystallize in the cubical form, others in columnar shape; we also have needle-like and hair-shaped crystals and, if these latter are flexible and subject to longitudinal division, we call them fibres.

It is this pecular form of fibrous crystallization—a mineralogical phenomenon—which gives asbestos its commercial importance, and the length, pliability and strength of the fibres determine the value of the asbestos.

Mineralogically there are quite a number of varieties of asbestos, but for present purposes it will suffice to confine our observations to the two chief subdivisions, namely chrysotile and amphibole, especially since nearly all the others occur in foreign countries.

This article dealing with facts and not with theories, we will not dwell on the reasons why one variety is different from the other, and what has made it so, but we will confine ourselves to the general statement that amphibole, which is much more abundant in the United States, is of much less commercial importance, as its fibre is weak and brittle, not adapted for spinning and weaving purposes, and is therefore mostly used in the form of very short and powderlike fibres for insulation and compounding purposes, for which, as a rule, the refuse from the big mills preparing chrysotile is employed and, while producers of amphibole claim a certain superiority of their material for certain applications, this does not do way with the fact that the main sale of their products is in those localities where freight rates are advantageous for them.

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An entirely new development for the use of amphibole is, however, being sponsored by inventors and industrial investigators, and as the preliminaries, though highly successful and yielding encouraging results, are not completed, this is the first public reference to the subject.

A certain grade of pure, preferably white and long fibred amphibole is selected and subjected to mechanical and chemical treatments, which do not, like in all previous attempts, destroy the fibrous character and reduce the amphibole to a more or less pulpy substance, but rather enhance the advantages to be derived from a fibrous structure, which purifies without reducing, and yields a product, eminently well destined to become one of the most important filtering media known to science and which will probably play an important part in many of our chemical industries, especially those where rapid filtration of vast quantities of liquids and great clarity obtainable during nearly uninterrupted working on a large scale is required. Since the processes of preparation and rejuvenation will be protected by numerous letters of patent, the United States bids fair to become a controlling factor in this field of endeavor.

When we come to chrysotile, however, our position as a nation is a most dependable, and therefore most deplorable and precarious one.

Due to the phenomenal strides, which our industrial life has taken during the last 10 or 15 years, and partly also due to our high standard of living, asbestos, and by this we mean now chrysotile exclusively, has become such an every day necessity, not only in our factories, but also in our entire transportation system, on the ground, on the water and in the air, as well as in every man's home, that even our engineers and leaders in industrial life are not aware of the paramount importance asbestos is having today, as this is the age of specialization, and a builder of aeroplane motors knows nothing of the problems of an engineer making underground railway cables, the manufacturer of refrigerators does not know that he is as dependent upon the same mineral—asbestos—as the stove manufacturer, and that neither of them

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could have obtained in his products our present day efficiency, were it not for this peculiar mineral asbestos.

The broad vision of the tremendous importance of the substance asbestos can be given only to those who follow it from the earth from which it is taken, through the many thousands of factories which fabricate it into the many millions of articles, in which it constitutes an integral and indispensable part.

Asbestos has become absolutely indispensable for the life of a civilized nation. There is no house heating unit, be it a central steam heating plant, or be it a kitchen or a kerosene stove, that would operate efficiently were it not for asbestos in the form of either pipe and boiler covering, or asbestos board, paper, felt or wick. No artificial ice could economically be made, no good ice-box could be kept in our homes, were it not for asbestos. Electrical wires, lamp sockets, bulbs even, every electrical contraption in existence, including flat-irons, vacuum-cleaners, also telephone and radio, would be impossible without asbestos.

In our industrial plants we can not conceive any more of a steam-pipe line without asbestos in every pipe joint, no locomotive is being run without asbestos in various forms in different parts thereof, no motor would function properly, no steam or motor propelled ship of the sea or the air could be operated, were it not for asbestos in a thousand and more different forms, shapes and applications, and if by an act of satanic influence asbestos were taken away from us tomorrow, even the visionary imagination of a Jules Verne were unable to grasp the calamitous consequences.

Where does this all important substance come from and what are the prospects of an uninterrupted and increasing supply?

The most productive mines in existence today are located in the province of Quebec, about 70 miles south of the city of Quebec, in a serpentine area, roughly speaking nearly 100 miles long and in width ranging from a few thousand feet to perhaps 5 or 6 miles.

This motherstone or matrix, serpentine, is more or less impregnated with veins of asbestos, which permeate it in the most irregular way, in all conceivable directions, sometimes splitting or coalescing, and even crossing each other.

These veins vary in width from microscopic dimensions to about three inches and a trifle more, and aside from local disturbances, the fibre lies in fissures at right angles to the enclosing walls.

Where these veins of asbestos have been found to be most abundant in the serpentine, we have today big quarries and mines. According to the statistics compiled by the Dominion of Canada, the year 1885 can be considered as the first one during which regular mining operations were conducted on a permanent and industrial scale, as there were then 7 quarries in operation during the larger part of the year, and a little over 1,000 tons of asbestos were produced. During the year 1925 over four million tons of asbestos bearing rock were mined, over 270,000 tons of asbestos were produced and the sales value thereof was close to $9,000,000.

*View of pit and lower end of incline railroad at Bell Asbestos Mines, Thetford Mines, Province of Quebec, Canada*

Before this industry could assume the present proportions, it has experienced many ups and downs, not a few of which were due to the technical difficulties, which opposed themselves to the economic working of the quarries and to the separation of the fibres from the rock, as all standard methods of ore reduction and concentration could not be applied, as this was the first time that a fibrous mineral was to be treated.

*Cobbing asbestos at the Regal Mine in Arizona*

Even today the prevailing methods of preparing asbestos for industrial uses will appear crude to the uninitiated, for the reason that the best qualities for spinning purposes are still exclusively prepared by hand labor and not by machinery.

As soon as the rock is blasted, all pieces containing asbestos veins, the fibre of which shows a length of ⅜ inch and more, are hand-sorted and brought to sheds, where they are subject to hand-cobbing. On staunch benches and tables, the surface of which is usually a heavy iron plate, the cobbers remove the rock containing no asbestos from the vein matter, and the latter is then hammered with lighter iron mallets to partly disintegrate the veins of asbestos, so as to be able to eliminate all rock particles still adhering to the outside, or embedded in, the asbestos veins. After careful screening and assorting the fibre according to length, all which is ¾-inch long and more is bagged as crude No. 1 and the material of ⅜ to ¾-inch fibre length goes as crude No. 2 to the asbestos textile plants.

The other rock mined and containing veins with asbestos of less than ⅜-inch fibre length has again to be assorted in such with enough asbestos to justify milling and such too lean or not containing any asbestos at all, so as not to uselessly

*Close-up view of entrance to underground workings and incline railroad of Bell Asbestos Mine, Thetford Mines, Province of Quebec, Canada*

burden the mill with dead rock. By far the larger part of the rock mined goes to the mill by hoist and aerial tramway, by inclined railway or other suitable conveyance, and while there are scarcely two fiberizing plants which follow exactly the same lines, the general practice is about as follows:

The first step is to dry the rock thoroughly, and this is either done in large rotary driers heated by wood or coal from the outside or by circulating hot air inside, or by using stack driers, and great economy is claimed for their operation. This rock, when still hot, is passed through large jaw crushers, some of which in the district are said to be the largest in existence, after which rotary or gyratory crushers, in some instances also rolls, continue reducing the rock pieces in size, thereby liberating already some of the fibre from the adhering rock and the whole ground-up mass passes over belts or shaking screens, from which the fibre is removed by air suction through inverted funnels, while the rocky particles, still containing much unopened fibre, go to various fiberizing devices, such as cyclones, beaters or pulverizers, but all reduction takes place step by step and after each milling or size-reducing operation the material travels over shaking screens, from which the fibre is again removed by air suction, while the fine rock particles pass through the screen to be reground and treated in a similar way, until even the shortest fibre, appearing to the naked eye nearly like dust, is also removed by air separation.

It is most important to reduce the asbestos rock gradually and to eliminate all fibre as soon as liberated, to prevent its being crushed by the next milling operation, as, the longer the fibre, the greater its value and the more it is crushed, rolled or ground, the shorter it gets.

When being lifted up by air suction from belts or shaking screens, the fibre is blown into bins or settling chambers, but it needs further cleaning, since small rock particles will always be carried along, especially with the longer fibres, and this is usually done by rescreening either on flat oscillating or in round rotating screens, which latter are also grading the asbestos into long, medium and short fibres, and most of the mills produce anywhere from five to ten or twelve different grades.

*Sorting and screening asbestos, Regal Mine, Arizona*

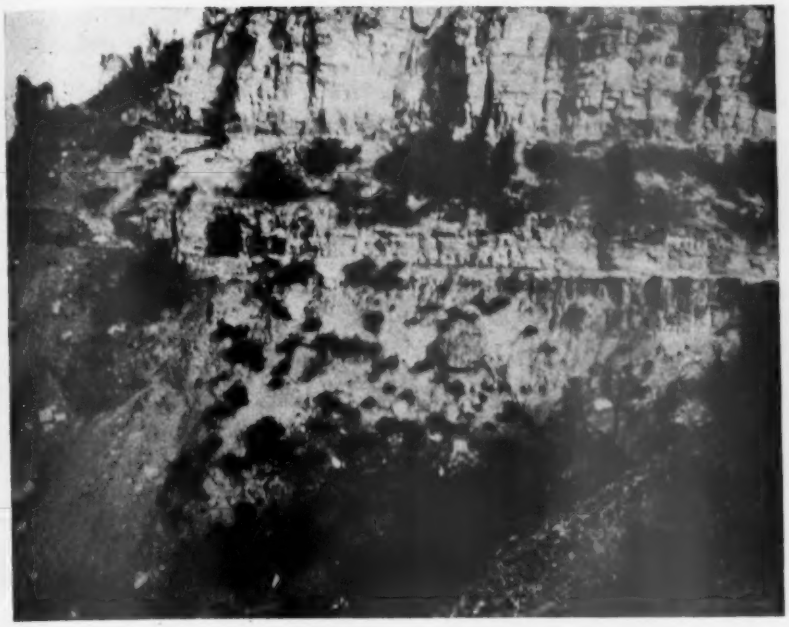
Having realized the importance of asbestos as a daily necessity, we can congratulate ourselves on having the main source of supply so near to our manufacturing centers. Of the approximately 270,000 tons of asbestos produced in Canada in 1925, about 210,000 tons were consumed in the United States, and in addition thereto we have imported from South Africa a few thousand tons more. Another possible source to supply part of our requirements could be Russia, but there are no other countries having developed asbestos deposits which could be of economical importance for us.

Should we complacently sit back and be satisfied that the asbestos deposits in Quebec are so near us and that South Africa is willing to help us out in a pinch?

It would be a national folly, the detrimental consequences of which can not be exaggerated. Yet no great exertion on our part is needed to counteract the Canadian monopoly and to make our industries independent of foreign supplies of this indispensable raw material, because Providence has blessed our country with very large and rich deposits of asbestos of a quality superior to that found anywhere.

Aside from several localities in California, Montana, Idaho, and Vermont, the commercial possibilities of which have not as yet been fully demonstrated, we have in the State of Arizona, and particularly in Gila County, not far from the well-known Roosevelt Dam, the richest deposits of the best quality of asbestos known to this day. While the Canadian rock, as mined now, yields less than one-half of 1 percent of "crude" asbestos, and does not average much more than about 6 percent of mill fibre, the peculiarities of the Gila County asbestos deposits have necessitated mining methods which, in many instances, yield nearly 10 percent of "crude" and frequently close to 20 percent of mill fibre per ton of rock mined.

This great difference in yield is easily explained by the fact that in Canada the asbestos veins are disseminated all through the rock, which requires the blasting away of whole mountains, while in Arizona the asbestos occurs in well-defined horizontal zones or blanket formations of comparatively narrow width, but highly enriched with asbestos veins, and between these zones of enrichment is barren rock, which need not be mined. Most of the mining done in Canada is open pit work, but in Arizona underground mining is exclusively practiced in the form of tunnels, crosscuts and stopes or working chambers. A typical adit or tunnel of an Arizona asbestos mine is about 6½ feet high and a little over



*Typical asbestos formation in Arizona*

4 feet wide. On both sides right above the floor we see an asbestos zone of about 12 to 15 inches thickness containing two and more veins of 1-inch fibre length and longer, and a great number of shorter ones. Above this, on both sides, will nearly always come about 3½ to 4 inches of barren rock, mostly limestone, and on top of this an asbestos zone averaging 18 inches thickness with veins varying from 3 inch to the smallest.

The Regal Asbestos Mine—which can be cited as typical, as it lies in the center of the whole district—situate in the Salt River Canon, a few miles above Roosevelt Lake, has its highest workings on a precipitous slope nearly 2,000 feet above and distant from the Salt River. About 100 feet below these highest workings, another fiberized double zone, like above described, is now being exploited, and all the way down to the river five more of such single or double zones of asbestos-bearing rock have been uncovered with anywhere from 100 to 350 feet of barren rock between them, and all layers of asbestos occur in nearly perfectly horizontal blanket formations of amazing continuity.

In this district, therefore, nature has given the United States one of the greatest treasures, which may one day become of incalculable importance for our national well being or even independence, but these rich deposits lie, for the most part, in a rugged canon country accessible to mountain horse and burro only, and most of them are 50 miles and more from the nearest railroad station, with roads passable for automobiles and trucks only part of the time and part of the way.

At the time of inflation, during the latter part of the late war and shortly thereafter, some of these mines could operate at a profit; for several years thereafter all of them were closed down, and at the present time only two of them, better and more intelligently developed than the others, are working a small force, and, while exercising the greatest economy and circumspection, they are the only ones courageous enough to carry on against odds and to battle against difficulties in the remote wilderness in true American pioneer style.

All these mines would need to free the American industries from the foreign yoke and to make them independent of outside domination, which has exerted itself, for instance, in 1920, by boosting the price of crude asbestors No. 1 from a prewar level of $250 per ton to over $3,000 per ton, would be a little help in road building and a little consideration in the laying of power lines. In nearly all of these mines drilling, as well as tramming and all other mine work, has to be done by hand, as the only fuel to generate power with, which could come in question, is oil or gasoline, and it has proven to be too expensive to transport it all or part of the way on burro back.

A surplus of electrical energy being available at Roosevelt Dam, and electricity being the ideal power for air compressors, mine haulage and asbestos fiberizing plants, all prerequisites are given for the establishment of a permanent and profitable asbestos-producing area in Arizona. The cost of building these roads and laying the power lines, however, is too great for the individual operators, but, in view of the national importance of asbestos, and the fact that these deposits in Arizona are the only ones known today, which could make us independent as a nation from foreign supply in times of stress, should induce the Department of Commerce to investigate the feasibility of cooperation between the political powers and the private operators to develop rationally this most important of our dormant national assets.

## LEGISLATIVE REVIEW

(*Continued from page* 175)

ported by the Senate Committee on Commerce. This bill proposes to allow the Federal Power Commission to use license fees under the water power act for expenses of its work.

S. 5322. Introduced by Mr. McKellar (Dem., Tenn.). Referred to the Committee on Commerce. This bill would forbid the Federal Power Commission from exercising jurisdiction over power development on non-navigable streams. The Senator offered it as an amendment to S. 5362 and other bills to force action.

S. 5370. Introduced by Mr. Copeland (Dem., N. Y.). Referred to the Committee on Commerce. This bill proposes to repeal the Federal Water Power Act and to confer authority for power development on the Interior and Agricultural Departments.

S. J. Res. 146. Introduced by Mr. Phipps (Rep., Colo.). Referred to the Committee on Irrigation. This resolution provides for the appointment by the President of five engineers to investigate the Lower Colorado River to report on feasible methods for the use of the water for production of hydroelectric power and other purposes. Two of the engineers would be appointed by the Interior Department, two from the War Department and one not in the Government service. The bill appropriates $100,000.

H. J. Res. 357. Introduced by Mr. Colton (Rep., Utah). Referred to the Committee on Irrigation. This is similar to the foregoing, except that it appropriates $175,000.

### Labor Laws

H. R. 17069. Introduced by Mr. Bacon (Rep., N. Y.). Referred to the Committee on Labor. This bill provides that contractors on Government works shall comply with state laws governing hours of labor and wages on state public works.

### Labor Safety

H. R. 12263. Reported by the Senate Committee on Labor. This bill, which has already been passed by the House, provides for the creation of a division of safety and a safety museum in the Bureau of Labor Statistics of the Department of Labor.

# MAGNESITE MINING IN CALIFORNIA*

## *Production Per Man Low Due To Care In Preparation Of Ore As Mined—Conchoidal Fracture Indicates Good Ore—Aerial Tramway Used—Product Marketed In Three States—Oil Burning Rotary Kilns In Use*

*By* LEROY A. PALMER†

ALL the domestic production of magnesite during 1925 came from two states, California and Washington. Of a total of 120,660 tons of crude ore, 64,600 tons, or 54 percent, were produced in California.[1] Of this quantity California produced about 99 percent of the caustic calcined, but only 10 percent of the dead-burned. The largest producer was C. S. Maltby, of San Francisco, who operated the Red Mountain Mine, in Santa Clara County, and the Sampson Mine, in San Benito County, under lease. These two mines have been studied by the author, and offer interesting comparisons as to mining and treatment methods and final products.

### GEOLOGY

The general geology of the magnesite deposits of California has been described by Hess,[2] Bain,[3] and others,[4] and although a detailed discussion is not necessary here, a brief summary will assist in understanding mining conditions.

California magnesite, when comparatively pure, is usually a white, fine-grained rock, with a conchoidal fracture, occurring in veins and lense-like masses in serpentine. The veins vary considerably in width, and usually occur in a series of more or less parallel veins intersected by other series or systems of veins, probably following original or secondary fissures in the enclosing serpentine. The most generally accepted theory of origin is that the magnesite was formed by the action of surface waters charged with $CO_2$ percolating downward through fissures and changing the magnesium silicates of the serpentine into magnesium carbonate.

### COAST RANGE DEPOSITS

The writer's observations have been chiefly in the Coast Range of California, in which his closest studies have been of the deposits at Sampson Mountain, in San Benito County, and at Red Mountain, in Santa Clara County.

Operations at the Sampson deposit have been in a quarry which has opened a wide vein to shallow depth only, so that no great opportunity is offered for study, but at Red Mountain a number of veins have been opened to a depth of several hundred feet, so that conditions are favorable for observing their characteristics. These observations indicate that the veins of the Coast Range are

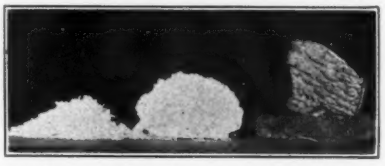


*Fig. 1.—Specimens of magnesite*

typical of those occurring in serpentine.

The Coast Range has a general northwest-southeast trend. The most widespread formation is the Francisan, the principal member of which is a massive greenish-grey sandstone which has been intruded by a number of large dikes and batholithic masses of ferro-magnesian rocks; pyroxenites, and peridotites. The magnesite is found in these basic intrusives, generally where they have been altered to serpentine.

Naturally, the intrusions were accompanied and followed by extensive faulting and fracturing, which opened many channels for the circulation of the $CO_2$ solutions, and the veins thus formed frequently have at least one well-defined wall, clean-cut and slickensided. This is particularly the case where the crushing has been on only one side of a major fault plane, so that the solutions have had easy access to a crushed zone that has led them away from the solid wall which was less susceptible to attack and chemical reaction.

### MOVEMENT OF OREBODIES AFTER FORMATION

The orebodies give ample evidence that considerable movement took place after they were formed. This movement was both lateral and longitudinal. It shows longitudinally in numerous strike faults that usually occur on the hanging-wall side of the vein. Dip faulting is not a common phenomenon, but there are numerous instances of lateral pressure in many distortions of the orebodies. The most noticeable of these is in the White Queen vein where the fracture zone and the orebody have been forced into a huge crescent having a large bulge in the middle and tapering ends.

The strike faults are usually on the hanging-wall side of the veins, and have resulted in smearing over the wall a layer of ore, varying in thickness from a few inches to 2 or 3 ft. This layer of ore acts as a protective seal of the wall, and prevents oxidation after the deposit has been exposed to the atmosphere by mining. It operates so usefully in this respect that, when its thickness is not so great as to represent a substantial loss, it is found advisable in mining to leave it, as the checking of the oxidation of the wall is a material assistance in supporting excavation.

Although general conditions favor the conclusion that the magnesite was formed by percolating water, the Red Mountain deposit gives interesting and indisputable confirmation. Open fissures have been found in which one wall bears a crust of magnesite such as shown by the right-hand lump in Fig. 1, the appearance of which leaves no doubt in the observer's mind that it was formed by water trickling over the wall. In fact, had the water dropped from the roof, instead of flowing over the wall, it would have resulted in a stalactitic growth instead of the crust observed. Even further confirmation is found in the fact that thin films of a similar nature have formed recently in some of the worked out and abandoned stopes.

Although there seems to be no reason to believe that the deposits at Red Mountain and Sampson Mountain are dissimilar in their origin, as both occur in serpentine, with like appearance on the surface, the Sampson deposit has not been developed to an extent that permits a satisfactory comparison of the two.

### MINING

The deposits in the vicinity of Red Mountain occur along fracture zones having a trend within a few degrees, either way, of north and south. The major fractures strike somewhat east of north, and are crossed by minor fractures that intersect them at acute angles. The dips vary widely, but average from 45 to 50°, and are generally in a westerly direction, although occasional easterly dips occur.

The veins vary greatly in width. The stopes are from 6 to 15 ft. wide, with an average of 10 ft. Extreme widths reach 40 ft., but this is rare. On the other hand, the mineralized area may narrow down to a mere stringer. When such contractions in the vein are encountered in horizontal operations, they are

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* Paper presented to New York Meeting, A. I. M. E., February, 1927. Copyright, 1927, by the American Institute of Mining and Metallurgical Engineers, Inc.

† Mining Engineer, San Francisco, Calif.

[1] J. M. Hill: Magnesium and its Compounds in 1925. Mineral Resources of the U. S. Bur. Mines (1926).

[2] F. L. Hess: Magnesite Deposits of California. Bull. 355, U. S. Geol. Surv. (1908) 17.

[3] G. W. Bain: Economic Geology (Aug., 1924) 419.

[4] See bibliography on magnesite by R. B. Ladoo. Non-Metallic Minerals (1925) 341.

followed out, and it is a frequent occurrence to find another swell with a body of ore of sufficient width to mine profitably. When such contractions are encountered in sinking, the indications are that they mark the lower limit of the orebody, thus adding support to the theory of downward solutions, although the deposit has not been followed to sufficient depth to prove this statement conclusively.

The Red Mountain deposit has been opened up over an area of several thousand feet in both length and width. A large number of veins have been discovered and considerable exploration work has demonstrated the existence of a deposit of unusual size. Knowledge of the actual extent is still limited, however, as almost the entire surface is covered by a growth of brush which is literally impenetrable. This is not causing any great concern at present, as the ore reserves are ample for the time being; but, when occasion arises, the brush will be burned and the surface given a thorough prospecting.

### Red Mountain Mines

The ore from the Red Mountain mine has been shipped from four groups of workings or mines, and three camps have been maintained. More recently, operations have been concentrated at the White Queen and White Diamond mines and carried on from one camp near the center of the property. Transportation from each mine is by aerial tramways, the two converging and dumping to the same bin at the calcining plant (see Fig. 2).

A large quarry was opened on the White Queen, on the crescent-shaped deposit mentioned, and a large tonnage was extracted before conditions became such as to render underground work more economical. Levels have been driven beneath this deposit and raises extended to it, and it is now worked by stoping. There are two levels, 100 ft. apart, but the principal production is from the White Diamond group.

At the time these notes were made one shoot on the White Diamond vein had been worked horizontally for 700 ft., through widths ranging from 3 to 20 ft., with an average of 10 ft. The shoot on the Smith vein, followed for more than 400 ft., has an average width of 6 ft. The Ollalla has been opened to a depth of 225 ft., with a length of 200 ft. on each level, the width ranging from 4 to 24 ft. and averaging 12 ft. The Ehrmann had an average width of 15 ft., through a vertical range of 200 ft., but development on this, the Cummings, and the Silver, has been of more limited extent than on the others. These figures are given somewhat in detail in order to convey some idea of the extent of the deposit.

The steep mountainside makes a condition that is ideal for operating through tunnels. The Diamond group has been opened for a range of 500 ft. through four levels. A main haulage way was driven and operated for several years until it was demonstrated that the ore extended for a considerable depth beneath it, and then the present haulage level was driven 175 ft. below the old one.

*Fig. 2.—Magnesite calcining plant at Red Mountain*

### Method of Opening a Deposit

In opening a deposit, a main entry is driven in the footwall parallel to the vein. These entries are 7 by 7 ft. in cross-section and require little timbering, as the unaltered serpentine is not materially affected by atmospheric agencies. At intervals of 150 to 200 ft. main raises are driven, with a cross-section of 5 by 7 ft. to the next level. These raises are carried in the footwall until they meet the vein, and this is then followed upward. Between the main raises, at intervals of 30 ft., secondary raises are carried up approximately 15 ft., at which level they have penetrated a few feet into the vein. They are then turned each way at angles of 45° and carried in the vein on this slope until they meet.

Stoping is then done by drilling holes in the back, and blasting down and drawing off only such ore as necessary to give working room. Occassional pillars are left to support the walls, but, with this exception the method is typical shrinkage stoping, and need not be described. Operations cease with a back from 6 to 8 ft. thick between the stope and the next level. This ore and the stope pillars will be removed when the time comes to abandon that part of the mine. Stoping is carried on by working upward from the main levels, driving a level in the vein to the end of the ore shoot and working backward until the ore is removed. Fig. 3 illustrates one of the stopes in the White Diamond mine.

### Impurities

No mechanical treatment of magnesite ore for improving its grade is practiced at the California mines, and consequently the impurities allowed in mining are restricted to narrow limits. Hand sorting is the only method of bettering, and consequently it is essential to break the ore in the stopes as cleanly as possible, and with no more admixture of wall rock than can be avoided. Furthermore, as has been noted, there is frequently a "gouge" along the hanging wall, which latter has been more or less shattered by the processes incident to the forming of the veins. This gouge acts much as a heavy layer of cement, and helps to keep the wall in place so that it is desirable to leave it undisturbed. This also calls for careful mining. For these reasons the tonnage mined per man does not approach that usually attained in shrinkage stoping in metallic minerals, which is generally carried on in low-grade deposits where a large tonnage is sought with the expectation that any lack of care in mining will be remedied in the mill. At the Diamond the gross output per man is from 3 to 5 tons, but when waste is sorted out and fines screened only 1 to 2 tons reach the kilns.

Main drifts, which have a cross-section of 7 by 7 ft., are driven with two miners and two muckers per shift. The men are paid $5.50 per shift, with a bonus of $1 per foot for every foot more than five broken per day. A standard center-cut round of from 12 to 15 holes is used, with about 50 lbs. of powder per round. From 5 to 6 ft. per round is the usual progress. These drifts cost about $6 a foot.

The raises are 5 by 7 ft. in cross-section, and cost $4 a foot. Stoping is done by contract. The company furnishes the machines and air, sharpens the steel, and trams the ore; the contractor furnishes labor and powder only.

The ore is loaded through hand-operated sector gates to 2-ton side-dump cars hauled by a gasoline locomotive with a Ford automobile engine. The various parts of the locomotive were hauled up the steep road to the mine and assembled there.

### Ventilation

The loading chutes are only a few hundred feet from the mouth of the haulageway, and ventilation conditions are such that there is always a strong outcast from the haulage level, so that the gasoline locomotive can be used with safety. Haulage is through a level driven for that purpose at an elevation of 175 ft. less than the lowest operating level.

At the mine bins the ore is dumped over a 1¼-in. grizzly, the undersize from

*Fig. 3.—Shrinkage stope in the White Diamond Magnesite mine.*

*Fig. 4.—Magnesite outcrop at Sampson mine*

which passes to a ¾-in. screen. This gives three products, lump for the stack kilns, fine ore for the rotary kiln and dust. The latter is wasted, as it is found to run high in impurities.

### Sampson Mountain

The surface of the claims at Sampson Mountain is covered by dense brush, characteristic of the Coast Range, so that, as at Red Mountain, it is impossible to obtain an adequate idea of the outcrops or of the extent of the deposit from a study of the surface. Here and there outcrops, some of them of unusual prominence, as illustrated in Fig. 4, indicate that the deposit is of great extent.

Production at Sampson Mountain is from a quarry on one of the large outcrops which has been opened by two benches, one 45 and the other 90 ft. above the haulage level. Each bench is reached by a raise, 4 by 4 ft. in cross-section, driven at an angle of 75° and lagged both inside and outside. The haulage level is 5 by 7 ft. in the clear, well-timbered, and 250 ft. long to the raise to the upper bench, the raise to the lower being at the 83-ft. point.

Fig. 5 shows the surface workings at the White Queen Mine. Fig. 6 shows the quarry on the upper bench of the Sampson Mine. The benches are worked independently of each other as quarries and not as glory holes. Faces are carried to a maximum height of approximately 30 ft. Mining is done by jack-hammers which receive air from an 8 by 6-in. Rix-Gardner compressor belted to a gas engine from a Kelly truck. All holes are vertical or nearly so, varying, according to conditions, from 5 to 15 ft. in depth, with a burden of 5 or 6 ft. The powder used is 40 percent gelatine.

### Sorting

The raise from the haulage level holes out into the quarry, and tracks radiate from it to the various faces. As the ore is broken down the larger pieces are blockholed, and it is sorted before being loaded into the cars. Color and weight are no guides to the sorters, who judge by the appearance of the fractured surfaces. A clean conchoidal fracture is an indication of good ore; an appearance of stringers or fibers on the surface indicates high silica and a rough, hackly surface lime.

Mining is done by contract, 15 men being employed for an output of 120 tons daily. Two of these men are miners, two are trammers, and the rest are sorters and muckers. The company furnishes the drills and sharpens the steel.

From the chutes the ore is trammed to a 100-ton bin, 150 ft. from the mouth of the tunnel. At the bin it is dumped over a ½-in. grizzly where a rejection is made of the undersize, as it is found that the fines of the first breaking are high in lime and silica.

### Transportation

At each locality the mine is well up the side of a steep mountain at an elevation considerably higher than the treatment plant, a condition making the aerial tram an ideal method of transportation.

There are two tramways at Red Mountain. At the White Queen a standard type of 2-rope aerial tram loads from a 200-ton bin and delivers at the kiln, 2,600 ft. away, after a drop of 600 ft. At the White Diamond there is a 100-ton bin serving a home-made "jig-back," having a drop of 425 ft. in 1,250, which is giving excellent satisfaction. Both tramways dump automatically at the kilns into a 150-ton bin having one compartment for lump ore for the stack kilns and one for fine ore for the rotary kiln.

At the Sampson, a standard type of 2-rope tramway with ½-ton buckets transports the ore 4,500 ft. horizontally, in which distance it is dropped 1,600 ft. and is dumped by hand into a 200-ton bin at the kiln. All ore at the Sampson is treated in a rotary kiln, so that all coarse pieces must be reduced prior to treatment. From the terminal bin the ore is fed without sizing to a 10 by 16-in. Hendy Blake crusher set to 2 in. A belt elevator raises the crushed product 24 ft. and delivers it to a 3 by 7-ft. trommel with 1-in. punched holes, the oversize of which goes to a No. 2 Telsmith gyratory crusher set to ½ in. Crusher product and trommel undersize go to the 80-ton bin from which the kiln is fed.

### Burning

Magnesite is marketed in three grades: Crude, dead-burned, and caustic calcined. The crude or untreated ore is used for various purposes, such as the manufacture of metallic magnesium, magnesia salts, paint, etc. Very little of the California product is marketed in the crude state. Dead-burned magnesite, which is the completely calcined product, has its principal use as a refractory. It should be free from $CO_2$ and carry not more than 2½ percent of CaO and 5 percent of $SiO_2$, and should contain from 7 to 10 percent of iron oxide. The caustic calcine—the "calcine" of the furnaceman—is the light-burned product, and is used for many purposes, such as plaster, cement, wallboard, pipe covering, sound insulation, etc. It has the same lime and silica content as the dead-burned, but should contain not more than 6 to 6½ percent of iron oxide, 3 to 3½ percent $CO_2$ is customary but up to 5 percent is permissible for most uses.

#### *Coarse Treatment*

At Red Mountain the coarse ore is burned in four-stack kilns and the fine ore in a rotary. The stacks are situated so as to be convenient to the coarse-ore bin, one being charged directly from the bin and the others by using short trams. Two sizes of kilns are in use, 6 ft. inside diameter with a capacity of 12 tons per 24 hr., and 7 ft. diameter with a capacity of 14 tons. They are oil-fired, with fire-boxes built around the base, and discharge to individual stacks, 2½ by 30 ft. A charge column of 18 ft. is carried, and the temperature maintained is from 1,800° to 2,000° F., under which conditions a period of 8 hr. is required to produce the caustic calcined product.

#### *Fines*

At the time these notes were made the fines at Red Mountain were being treated in a Scott furnace, which has since been supplanted by a rotary kiln. As the rotary treatment is described in some de-

tail in connection with the Sampson, only the former method of treatment in the Scott furnace is considered here.

The oversize from the trommel at the mine, 1½ to ¾ in., is dumped to separate compartments in the bin at the kilns. From these bins it is fed through a hand-operated gate to a conveyor, 125 ft. long with a rise of 25 ft., which also serves as a picking belt. The serpentine and other impurities are picked out and the ore is discharged to a 50-ton bin, from which it is loaded to cars and trammed to the Scott furnace.

The Scott furnace was designed originally for treating quicksilver ores, and this particular furnace was moved in from a near-by quicksilver mine. It is rectangular in cross-section, 16 by 24 ft., 33 ft. high, and is equipped with an oil fire-box at each end. On each side of the furnace there is a series of inclined shelves pitching in opposite directions, so that the ore slides across one shelf and falls from the bottom of that shelf to the top of the one below it and thus slowly runs or "trickles" from top to bottom of the furnace, during which passage it is subjected to the heated gases from the fire-boxes passing through the stack.

*Rotary Kiln*

The Scott furnace has been successful in treating quicksilver ores, and has made a satisfactory product in treating the magnesite, but was discarded in favor of the rotary kiln because of the greater capacity of the latter.

At the Sampson Mine all treatment is in a rotary kiln which makes either dead-burned magnesite or caustic calcine, according to the market demand. The kiln, Fig. 7, is 80 ft. long, and is set with a 16 to 1 pitch of 5 ft. The outside diameter is 7 ft. but this is reduced to 6 ft. inside by the fire-brick lining, and further tapered at the stack end to 4 ft. for the purpose of reflecting the heat back toward the fire-box. An eccentric feeder delivers the crushed ore from the bin to a chain elevator which raises it 12 ft. and discharges it to a water-jacketed feed pipe to the kiln. Fig. 8 shows the tramway bins, crushing plant, fine-ore bin, and stacks of the rotary kiln.

*Grading*

The grade of the product—that is, whether dead-burned or caustic—is governed by the heat in the kiln. For dead-burning this is 2,800° F. in the fire zone, which is from the 10 to the 20-ft. point, reckoning from the fire-box end. With this temperature in the fire zone the stack gases are at about 1,000° F. In dead-burning, the kiln is given an extra lining in the fire zone by fusing 3 or 4 in. of magnesite dust onto the lining under high heat for about 24 hr. At the time of the author's visit about 4,000 tons of dead-burned magnesite had been produced with the lining then in use, and it was still in good condition.

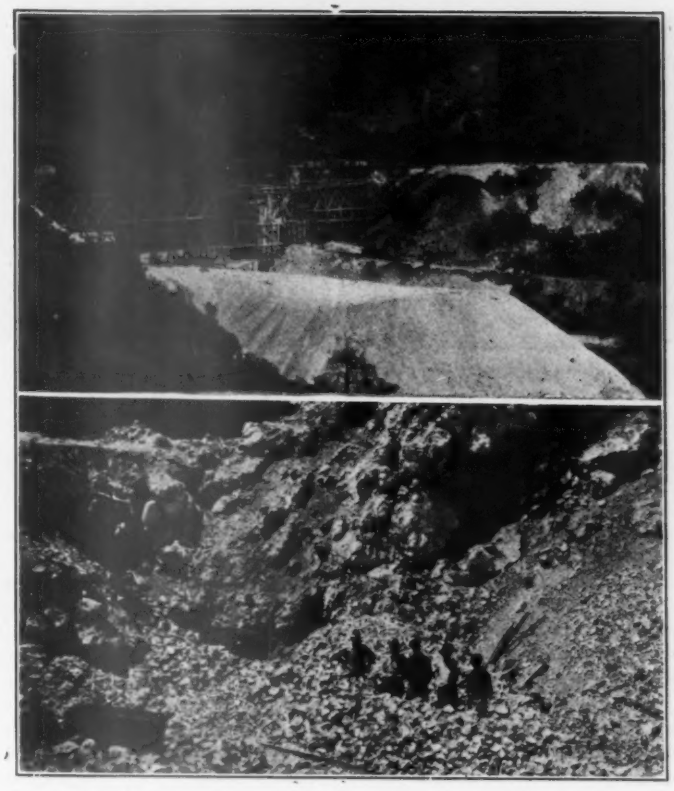


*Fig. 5.—Surface workings at White Queen mine, with quarry in the background.*

*Fig. 6.—Quarry on the upper bench of the Sampson mine.*

As the Sampson ores are deficient in iron, which is necessary in the dead-burned product, it is added in the form of mill scale. This is stored in a small bin beneath the ore bin and discharged by an eccentrically-operated feeder to the chain elevator that carries the ore to the kiln.

Caustic calcine is produced in the same manner as the dead-burned but at a lower temperature, 2,200° F. in the fire zone and 400° F. in the stack. With this more moderate temperature the reinforcement of the lining is not necessary.

The kiln makes a revolution in 80 sec., and has a capacity of 35 to 45 tons of dead-burned per 24 hr. according to whether the product is burned to a light brown or a black. The analysis of the two is the same, except for a difference in ignition loss, but the black commands a somewhat higher market price. The capacity for caustic calcine is higher than for dead-burned, as the kiln can be fed more heavily and produce 60 tons per 24 hours.

An interesting feature of the process is the fact that the change in the character of the product appears to come suddenly as it passes through the kiln. When a kiln that has been making dead-burned is shut down and cooled, the first 30 ft. (approximately) are found to contain dead-burned magnesite, after which there are 10 ft. of over-burned caustic, then 10 to 15 ft. of caustic, and the remainder is raw ore. These grades do not merge; there is a sharp line of demarcation between each.

FUEL

The kiln is oil-fired, and consumes 60 gal. of fuel oil per ton of caustic and 70 gal. per ton of dead-burned. It has two stacks, 30 in. by 50 ft., which give a natural draft of 4 in. of water. Between the kiln and the stacks is a dust chamber, 10 by 16 ft., 14 ft. high, with a baffle wall. This chamber settles out the fines from the kiln and, as they are too high in lime and silica to justify recovery, they are wasted.

Labor consists of one man at each tramway terminal, one crusherman, one blacksmith and general utility man on day shift, and two men at the rotary kiln on both day and night shifts.

HANDLING KILN PRODUCT

The product of the Scott kiln is raked onto a hearth, where it cools and from which it is trammed to a chain elevator to the shipping bin.

The product of the stack kilns, which make only caustic calcine, is raked out onto concrete floors and spread in heaps 1 ft. thick for cooling. When cooled it

*Fig. 7.—Rotary kiln at the Sampson Mine*

*Fig. 8.—Tramway bins, crushing plant, and stacks of the rotary kiln, at the Sampson Mine*

is shoveled into wheelbarrows and dumped into hoppers feeding an inclined conveyor, 205 ft. long, with a rise of 15 ft. This conveyor is used as a picking belt. One man, stationed at the feed hopper, picks out the serpentine and throws it to the waste bin. Three or four other pickers, stationed along the belt, pick out the pieces that are good magnesite as far as composition is concerned but are off color and consequently not adapted to the many uses that require the pure white material.

In calcining, many of the larger lumps do not "cook" through. The process of calcining causes the thoroughly treated ore to take the form of needle-shaped crystals in radiated groups. These groups crumble very easily, the individual crystals falling apart. When a piece of ore does not cook thoroughly the result is an egg-shaped core surrounded by crystals of calcine. Obviously, a separation of the partly raw ore and the calcine is necessary, and this is effected very simply. The picking belt dumps to a 3 by 7-ft. trommel with 1-in. holes, and the tumbling about in the trommel breaks off the crystals; these pass through the holes and the partly raw cores are discharged from the end as oversize and returned to the kilns. One of these pieces of partly cooked ore is shown in the middle of Fig. 1, and at the left is a small pile of the thoroughly cooked needle-like crystals which have been rubbed from the center chunk. The tonnage ratio of the original charge to the kilns to the final product in the bins is about 2½ : 1, with a consumption of 1 bbl. of oil to a ton of calcine.

As all the kiln output at the Sampson is finished product, it goes directly to the shipping bins without further treatment. A bucket-and-chain elevator, running at an angle of 45°, discharges it directly to the dead-burned bin or to a screw conveyor which carries it to the calcine bin. The dead-burned bins are of timber frame with a lining of two thicknesses of fire-brick laid with an air-course between to facilitate cooling. The caustic bins are steel-lined and have steel hopper bottoms.

### Power

The power requirements at both mines are small. At Red Mountain three Chicago compressors, each with a capacity of 300 cu. ft. per min., are connected straight-line to 9½ by 14-in. semi-Diesel engines, and furnish air for the drills and for a water pump to the mine. One 60 H. P. boiler supplies steam for spraying oil to the kilns and for four small (5 to 10-H. P.) engines which operate the elevating and conveying machinery and oil pumps.

At the Sampson a 65-H. P. return tubular boiler furnishes steam for the oil burners and for two engines, one 75-H. P. which operates the kiln, crushers, elevators at crude bins, and electric light generator, and one 20-H. P. for the elevator for the finished product and the screw conveyor at the calcine bin. As previously noted, the compressor at the mine is run by a gasoline engine.

### Freighting

From the Red Mountain Mine there is a 32-mile haul to Livermore, on the Western Pacific Railroad, and one of the main lines of the Southern Pacific Railroad. The product from the Sampson is freighted 45 miles to Mendota on another of the main lines of the Southern Pacific Railroad. Haulage is by motor trucks.

The mountains of the Coast Range are cut by many steep canons, so that the roads are frequently narrow and tortuous, although the grades are not bad. Where sandstone predominates in the formation there is a good natural roadbed and cuts stand well; but where shale lenses come into the sandstone, as occurs frequently, road trouble is very apt to be encountered, both in hauling and in maintenance. Although freighting does not present any really serious obstacles, it is not entirely easy.

Acknowledgment for assistance in collecting these notes is due to C. S. Maltby, lessee of the two mines, Ralph H. Moore, one of the owners of the Sampson Mine, E. Freitag, superintendent of the Sampson Mine, and Roy H. Clarke, superintendent of the Red Mountain Mine.

## MINING ALABAMA IRON ORES

A study of iron-ore mining practice in the Birmingham district, Ala., has been made by the Bureau of Mines. The rapid development of this iron-ore mining district has been made possible by investigations that have led to radical changes in furnace practice. Studies of methods by which the low-grade, high-silica ores may be treated by concentration will give still greater impetus to development, states Dr. W. R. Crane, in a report on this subject. Should beneficiation make available the high-silica ores of the lower bench of the Big Seam, the most important of the ore beds, mining practice must necessarily be adapted to the new conditions and will be rendered more difficult as the weight of cover increases at long distances from the outcrop. The support of workings will require more attention as the weight of cover increases, and the efficient and economical operation of the mines will depend largely upon improvements in mining and handling the ore.

Mining of the red iron ores of the Birmingham district has gone on energetically for the past 50 years and has created a large iron and steel manufacturing center. The district produces about 10 percent of all the iron ore mined in the United States, and 80 percent of the Alabama output is red ore; moreover 43 of the 419 blast furnaces of the country are in the district tributary to Birmingham and produce 7 percent of the pig-iron output.

The mode of occurrence of the ore has made mining practice comparatively simple, but with the rapid extension of the workings underground and the disturbed condition of the ore bed some distance from the outcrop conditions tend to become more difficult. Stoping, handling, support, drainage, and ventilation are all affected, sometimes favorably and sometimes adversely, by the extended workings and increased depth of cover.

In Bulletin 239, just issued by the Bureau of Mines, suggestions are offered for improved and changed ore mining practices that investigations have shown may be necessary with future development. The character and occurrence of the ores are discussed, and mining methods are analyzed in detail, with special reference to the support of mine workings and the handling of ore. Copies of Bulletin 239, "Iron-Ore (Hematite) Mining Practice in the Birmingham District, Ala.," may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

# BAUKITE—A NATURAL REFRACTORY

***Recent Tests Of This Unusual Material Show That It Will Resist A Temperature Of 5800° F. Without Fusing, Spalling Or Cracking—It Has An Exceedingly Low Range Of Expansion Or Contraction And Is Neutral To Either Basic Or Acid Slag Action***

*By* R. E. DAVISON*

BAUKITE is a natural refractory which occurs in a stratified formation, belonging to the lower Silurian period and is of the Occoee Algonkian group of Metamorphic or Transition rocks first discovered in the Unaka range of mountains. The rock itself has the appearance of a sandstone made up of rounded grains, held together by its own matrix, differing from ordinary sandstone from the fact that the grains have no sharp edges. The Tennessee deposit is uniform, varying in thickness from 100 to 150 feet, taking a course of northeast and southwest, forming the backbone or apex of a ridge, as before stated, being one of the parallel ridges that goes to make up part of the Unaka Range. The deposit has a dip of about 35 degrees to the southeast. At many points along this lead the rock is shown to be from 300 to 400 feet wide, and this deposit extends as a part of the formation of the ridge for a distance of 1½ to 2 miles.

It is estimated that this material in place will weigh about 100 pounds per cubic foot, its specific gravity being 2.3, so that where a measurement can be made on three sides, it can be estimated that this deposit alone contains many millions of tons of available material.

The material is produced by open-cut quarrying.

It has been found that further efficiency of this material is obtained by mixing with the ground bauKite rock, which is reduced to about 100 mesh, a soft sedimentary material or deposit which seems to be the result of a trituration of the bauKite rock, redeposited at the lower edge of the bauKite rock deposit. This soft material has practically the same chemical analysis as the raw bauKite rock, and when mixed in the right proportion with the bauKite rock shows a far greater heat resistance than when either the rock or the soft material is used alone. This fact is proven by the Bureau of Standards.

From all practical tests made by users of refractory materials, bauKite is found to be far superior to any manufactured material now on the market.

BauKite is used in the manufacture of crucibles, flux-blocks, tank-blocks, glass-pots, zinc-pots, saggers, etc., giving to these articles greater stability and greater resistance to heat as well as chemical action of any kind, since it is neutral to either basic or acid slag action. Furthermore, as bauKite has an exceedingly low range of expansion or contraction, under heat it neutralizes whatever expansion or contraction may be in the clays with which it is used. BauKite, in combination with known binders, is used as a cement for laying up fire-brick and coating over same by the use of trowel or cement gun, thereby making a homogeneous heat-resisting surface. In this way it is used for lining steel ladles, soaking-pits, annealing furnaces, open-hearth furnaces and brass furnaces; in fact, any place where high heat is encountered.

At a heat-resisting demonstration made at a meeting of the American Mining Congress, held at Memphis, Tenn., in March, 1926, a small briquet made of baukite resisted the action of an oxy-acetylene torch developing a temperature of 5,800 degrees Fahr. under pressure, one-half inch radius for 20 minutes without fusing, spalling or cracking.

A coating of bauKite one-fourth inch thick as a lining inside a 100-ton steel ladle recently stood 19 heats before exposing the brick.

A chemical analysis of this material as mined by the American BauKite Co. is as follows:

| | Percent |
|---|---|
| $SiO_2$ | 96.19 |
| $Al_2O_3$ | 1.86 |
| $Fe_2O_3$ | .29 |
| $TiO_2$ | .91 |
| CaO | .07 |
| MgO | .10 |
| Alkali | N. E. |
| Loss | .58 |
| | 100.00 |

## FURTHER NOTES ON BAUKITE

*By* HENRY MACE PAYNE†

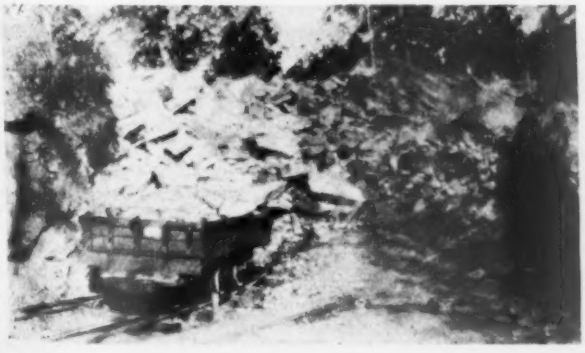
The development of bauKite, since its first production in Tennessee, has been gradual and permanent. Because of the similarity in name to bauxite, which runs much lower in silica and higher in alumina, and is more pisolitic, many users of refractory clays were slow to recognize the new mineral.

The Tennessee product varies by less than 1 percent in analysis from the Austrian material of the same name, and the deposit opened about a year ago in Winston County, Miss., maintains the same characteristics. The best known silica refractories fuse at about cone 31, while bauKite may conservatively be said to fuse at from cone 32 to cone 33, and tests with it have been reported as withstanding cone 42.

When heat is gradually applied to bauKite, a glaze forms as the maximum temperature (*Continued on page* 186)

* President, American Baukite Co., New Kensington, Pa.

† Consulting engineer, American Mining Congress.



*BauKite quarry at Apison, Tenn.*

*Mill end of tram line, American BauKite Co.*

# MICA IN 1926

## *Mica Is Produced In Twelve States, New Hampshire Leading, With Sixty-Two Percent Of Total Production—Industry Increasing In Size Annually*

*By* J. A. ROGERS *

THE mica industry of the United States is beginning to assume its place as one of the important and essential industries of this country. The more important research laboratories have about given up hope of finding a satisfactory substitute or of being able to produce mica synthetically. It is rather interesting to read in Hitchcock's "Geology of New Hampshire," published in 1846, the prophecy that many new uses would be found for mica and that the consumption of this commodity would be greatly increased. Mr. Hitchcock, at that time, possibly never dreamed of the tremendous extent or of the supreme importance of mica to the electrical industries, and its influence on present day civilization.

Owing to the continued expansion of the electrical industries, in which mica is absolutely essential, the consumption of mica has been increasing annually for some years past. Much of the sheet mica produced does not possess the requisite qualities for use in the manufacture of high grade electrical equipment and is sold for other purposes. Part of this material is utilized in the manufacture of heating units that have wide spread application in many heating utensils. Because of its transparency and heat resisting qualities mica is serviceable as a glazing material at points where tempertures are above normal. It is therefore extensively used in stoves, baking ovens, furnaces, gas light chimneys and fuses.

From many mines the total output of mica, that can be manufactured into sheets, seldom exceeds 15 percent. In the early years of the mica industry the rejected material was mostly waste; today this scrap is in active demand for grinding purposes and the demand now exceeds domestic production. The increasing use of ground mica in many industries has afforded a good market for mine scrap from the rough cobbing sheds and shop trimmings from the production of sheet mica.

Mica is being mined in 12 different states of importance in the order mentioned: New Hampshire, North Carolina, Alabama, Colorado, Connecticut, Georgia, New Mexico, Virginia, Nevada, Maine, South Carolina and South Dakota. While New Hampshire was the first state to produce mica, production having been begun there in 1803, North Carolina was the leading state in production from the time Government records were kept in 1876 until 1921, when New Hampshire forged to the front with a production of more than twice that of North Carolina and more than 50 percent of all the mica produced in the United States and continuing in the lead since that time. In 1925 New Hampshire produced 62 percent of the total quantity of domestic sheet mica produced in the United States, as compared with 51 percent in 1924.

The average value of sheet mica in 1925 was $360 per ton. The average value of scrap mica in 1925 was $24 per short ton, as compared with $19 per short ton in 1924. This increase has been largely due to the larger production of the Ruggles and Valencia Mines, operated by the Standard Feldspar Co., of Rumney Depot, N. H., and the operation of the Alexandria Mine, near Bristol, N. H., owned and operated by the General Electric Co., which has accounted for part of the increased production of that state. The sales of sheet mica by producers in North Carolina in 1925 were 33 percent of the total, as compared with 41 percent in 1924. Sales of scrap mica, however, increased 59 percent over 1924 and were 53 percent of the total scrap mica sold by producers in the United States. This increase in the output of scrap in North Carolina has been due largely to the activity of feldspar miners and the accompanying increase in the production of scrap mica as a by-product, incident to the mining of feldspar.

Government reports for 1926 are not yet available, but indications are that there was an increase both in production and in prices for that year.

* Treasurer, Standard Feldspar Co., New York City.

### HIDDENITE IN NORTH CAROLINA

After a lapse of around a quarter of a century, hiddenite, said to be the rarest of gems, is again being produced near Hiddenite, Alexander County, N. C., according to Maj. Wade H. Phillips, director of the State Department of Conservation and Development.

Hiddenite, according to geologists, is found exclusively in North Carolina, where mining operations ceased in the latter part of the last century on account of its scarcity.

A pocket, lined with quartz crystals and embedded with the precious gem, was found recently after exhaustive drillings. A number of the gems have been identified by Dr. Joseph Hyde Pratt, former state geologist and a recognized authority on gems.

Hiddenite is classed as a species of the emerald, ranging in color from a yellow to a green. The gem was named for William Earl Hidden, a mineralogist, who is credited with having recognized a specimen which he examined after its discovery in 1853 as a new gem. The town of Hiddenite was also named in his honor. Suggestion of the name was made by J. Lawrence Smith, a chemist.

### NEW RESEARCH LABORATORIES

Announcement is made of the opening of the Double "EE" Research Laboratories, located in Fullerton, Calif., which are prepared to handle metallurgical work of all kinds, assays and analysis as well as surveys, engineering estimates, commercial processes and cost accountings with processes installed. Careful study has been given to the conditions of the ores of Southern California. They specialize in complex ores and offer an invitation to the mining public to send their samples for testing. The company also announces the appointment of Edwin C. Jordan as head metallurgist.

### BAUKITE

(*Continued from page* 185)

is reached, preventing all spalling and forming an impenetrable coating.

Its neutral qualities and minimum expansion and contraction make it of extreme value for saggers, kiln linings, ladle linings, and fire-box repairs. When ground from 60 to 100 mesh, and mixed with 25 to 40 percent of any high-grade refractory, its application with the cement-gun is an inexpensive method of relining and repairing.

Experimental work is now being carried on to determine the exact mixture which will produce the longest lived brick with a bauKite base. The Tennessee deposit is near Apison, Tenn., and the Mississippi deposit is shipped over the Gulf, Mobile and Northern Railroad from Louisville, Miss. This latter deposit lies horizontally about 150 feet above railroad level and is operated by open-quarry methods. Its depth has not yet been determined, but its outcrop may be traced for over a mile, and the deposit extends entirely through the hill, aggregating many millions of tons with an overburden of zero to 10 feet. More than 40 different tests are now being conducted with this material, and as yet no commercial failures have been reported.

It would seem that bauKite is a superrefractory with a wide range of application, and that it may be added to any other refractory material with impunity, thereby raising the fusing point and adding both life and strength to the product.

# NEW POTASH FIELDS OF THE UNITED STATES*

*A Description Of The California And Utah Lake Bed Operation—Disposition Of By-Product Borax A Problem—Discussion Of Drilling In Utah, Texas And New Mexico—Deeper Exploration Necessary*

By G. R. MANSFIELD†

STRICTLY speaking, there are no new potash fields in the United States, unless Grand County, Utah, may be so considered. Practically all the potential potash-bearing fields have been under observation since 1912 or earlier, and more or less is already known about them. There are, however, four general areas that have been attracting interest lately as possible sources of potash production. These are Searles Lake, Calif.; Great Salt Lake Desert, Utah; Grand County, Utah; and western Texas-southeastern New Mexico. They will be described in the order named.

## SEARLES LAKE

The salts at Searles Lake were discovered as early as 1862 by John W. Searles, who was then prospecting for gold in the Slate Range to the east. He paid little attention to them at the time, but in 1873, with E. M. Skillings, he located parts of the area for borax. Probably the first to suggest that potash might profitably be produced from this source was Whitman Symmes, who, in 1898, was superintendent of the California Borax Co., operating at Searles Lake. The announcement which directed public attention throughout the country to Searles Lake as a possible source of potash was made in 1912 in a joint press bulletin issued by the U. S. Geological Survey and the Bureau of Soils. Although several companies have tried production of potash at Searles Lake, the American Trona Corporation, which was the original producer, is the only one to attain what might be called commercial success. This company, now known as the American Potash and Chemical Corporation, had early acquired considerable holdings at the lake, and by 1916 had produced about 120 tons of concentrated potash and borax salts. The plant was shut down in 1921, but was reopened in 1922 and since then has been operative on an expanding scale.

Dr. John E. Teeple, consulting chemist of the corporation, stated, in an address before the Institute of Politics, at Williamstown, Mass., last summer, that the plant at Trona, on Searles Lake, was producing 85 percent of all the American production, which in 1925 was 25,439 short tons of $K_2O$ (Bureau of Mines figures), and he forecast for 1927 a production of 56,000 tons of $K_2O$ for his company. According to his figures, the brine, which contains 35 percent of total solids, includes 4.75 percent of potash in the form of potassium chloride. On the present scale of operations the plant will be turning out 1 ton of potash or borax every four minutes next year (1927). Every minute of the year the plant will receive 4 tons of brine from the lake, evaporate 2½ tons of water, separate more than 1 ton of undesired salts, and make 500 pounds of marketable potash and borax. The plant now competes in the potash and borax markets of the world in spite of paying $2,500,000 a year freight on borax. He states that in time of stress it will be easily possible to build within a year plants enough on this lake to supply all the potash we need. He did not, perhaps, sufficiently emphasize the limitation imposed on potash production at Searles Lake by the necessity of disposing of the by-product borax, which must be sold in a highly competitive market.

## GREAT SALT LAKE DESERT

The desert west and southwest of Great Salt Lake in Utah contains two exposed salt bodies and is underlain by brines that are unusually simple in composition, consisting chiefly of the chlorides of sodium, magnesium, and potassium. The larger salt body centered about Salduro, on the Western Pacific Railroad, has for some time been a source of production of common salt, and during the war potash was produced from its associated brines. In 1920 the Utah Salduro Co., at Salduro, was the largest individual producer of potash in the country. Shortly thereafter potash production was discontinued at this plant and has not been resumed. Interest in this area as a source of potash has continued, however, and attempts have been made to raise capital for potash operation here on a large scale. There has also been great activity in securing prospecting permits, for under the terms of the act of October 2, 1917, permittees may, under certain conditions, obtain patents for one-fourth of the area affected by their permits.

In the administration of these lands the Department of the Interior found it desirable to differentiate between land that should be leased under this act and land that should be subject to prospecting. T. B. Nolan, of the Geological Survey, was accordingly assigned to this work, and in 1925, in cooperation with members of the Bureau of Mines and General Land Office, he made a large number of borings systematically placed in the Great Salt Lake Desert, and obtained samples which were analyzed in the Survey laboratories. His report, which includes a map and a discussion of his findings, is now in course of publication by the Survey.

The average of 199 samples collected by Mr. Nolan showed that the brine contained 2.89 grams per liter of potassium, equivalent to 3.48 grams per liter of $K_2O$, or to about 0.3 percent of $K_2O$ in the brine. He found that the brine was relatively localized and varied in composition with the character of the bed rock exposed in the tributary drainage area. For example, samples collected from areas adjacent to magnesian limestones were relatively high in magnesia, while those adjacent to granitic rocks were correspondingly high in potash. The brine in the different borings came from several layers, some of which were a mere fraction of an inch thick. The flow from some layers was fairly rapid, but from others it barely trickled. His work raises the question if the supply of brine available by surface trenching is sufficient for large scale operations without resort to deeper seated brines. A deep well at Salduro has shown within a depth of 200 feet five horizons that yield brines similar in character to the shallow brines. The deeper brines would probably be even more localized than those near the surface, because of the control exercised by buried topography. In view of the fact that by relatively simple treatment these brines may be made to yield not only common salt and potash, but also magnesium chloride, as a by-product, a study of the nature and abundance of the deeper brines in this region would be highly desirable.

## GRAND COUNTY, UTAH

The Cresent Eagle well, 7 miles west of Thompsons, Grand County, Utah, has furnished samples of salts reported to come from a depth of 3,150 feet. As analyzed these proved to be nearly pure carnallite, containing 13.9 percent of potassium as compared with 14.1 percent for the pure mineral. Samples of salts reported from depths of 3,910 to 3,917 feet in the same well were much like the salts from the higher level in appearance, but yielded on analysis 49.05 percent of $K_2O$. This high percentage of $K_2O$ appears to indicate a mixture of

* Presented ex tempore before the Washington Section, A. I. M. E., January 10, 1927. Published by permission of the Director, Geological Survey.

† Geologist in Charge, Section of Metalliferous Deposits, U. S. Geological Survey.

## SECOND ANNUAL INDUSTRIAL DEVELOPMENT CONFERENCE

**THE tentative program already prepared for this conference which is to be held at the Hotel Tutwiler in Birmingham, Ala., March 21-22, includes addresses by Mr. W. L. Stanley, vice-president of the Seaboard Air Line Railway, on "The Function of Transportation in Industrial Development," and McKinley W. Kriegh, of the American Mining Congress, on "Simplification of Federal and State Taxation Problems."**

**Mr. L. J. Folse, of the Mississippi State Board of Development; Mr. R. G. Brown, of Louisville, Miss., and others interested in the development of new industries to take the place of lumber and to bring about the utilization of cut-over land, will tell what is being accomplished in Mississippi. Judge J. H. Hand, of Yellville, Ark.; Mr. J. M. Mallory, Industrial Agent of the Central of Georgia Railway, and others will recount the progress that is being made in their states. Richard H. Edmonds, Editor of the Manufacturers Record, will send a message of industrial cooperation, and Dr. Henry Mace Payne, Consulting Engineer to the American Mining Congress will recount the advances which have been made during the past year.**

**On Monday evening an informal dinner will be held at the Tutwiler Hotel, at which brief addresses will be made by visiting bankers and delegates, who have come to better acquaint themselves by first hand information, with the resources represented and the people who are identified with the progressive movement of the present South.**

**The Conference will continue on Tuesday morning, with addresses and discussions by outstanding industrialists and representatives of the various Chambers of Commerce and delegates appointed by the several Governors. At the close of this session, officers of the Southern Division will be elected for the ensuing year, and it is hoped that a definite program may be adopted for the furtherance of the work so encouragingly started at the initial conference held in Memphis in 1926.**

**Following the Birmingham gathering, an excursion has been arranged for visitors interested in seeing some of the newer developments in nonmetallics, in Mississippi. The party will be the guests of the Gulf, Mobile and Northern Railroad, and will inspect the new state docks at Mobile, thence through the fruit, horticultural and agricultural districts of southern Mississippi to Laurel, visiting the fibre board and other plants there, and proceeding to Louisville, Miss., the center of the great mineralized section of the state, where a day will be spent in visiting the new coal mine, the deposit of bauKite (the new super-refractory), beds of fuller's earth, kaolin, glass sand, pottery and slip clay, from which point the special car will move to Blue Mountain where a visit will be made to the novaculite and paint pigment beds.**

**From this point the party will move to Amory, where automobile trips will be made to the new gas well, and through the active drilling operations along the Cincinnati Arch, and up to the asphalt rock and ochre deposits, after which the visitors will leave for their respective homes.**

**The American Mining Congress sent out a questionnaire to 8,000 southern business and professional men, inquiring as to the outstanding economic problems of the South and how best they may be solved. One of the features of the Birmingham meeting will be a symposium and discussion of the several hundred replies which it is hoped may voice a united purpose to effect definite steps for better knowledge, better utilization, and broader development of the great natural resources of the South.**

carnallite and sylvite. No sulphate was present. There are no check wells in this vicinity as yet, but much interest has been aroused, many permits have been applied for, and some have been granted.

William Armstrong, of Los Angeles, reported to represent other financial interests, is now making a core test about 1 mile southeast of the Crescent Eagle well. He had expected to complete the well at about 3,000 feet by February 1. At the end of December, however, the test had penetrated to the depth of 1,400 feet without encountering the salts. The results of this test will be awaited with interest, and it is hoped that the core may be available to the Geological Survey for study and analysis. Mr. Armstrong has taken another permit about 15 miles southwest.

### Texas-New Mexico

The great Permian salt basin, extending from southwestern Texas, through southeastern New Mexico, into Oklahoma and Kansas, has long been looked upon as a possible source of potash because of its geological relations. The first discovery was made by Udden in 1912 in brines taken from the Spur well, in Dickens County, Tex. The findings in the Boden and Miller wells, in the Panhandle section followed in 1915. The first cuttings of polyhalite were obtained in 1921 from the Bryant, Burns, and River wells, in Midland, Dawson, and Ward Counties, Tex. The discovery of oil in Reagan County, Tex., and later elsewhere in the region, gave new impetus to drilling and new discoveries of polyhalite followed rapidly. There are now about 70 wells in 18 counties of Texas and 6 wells in 3 counties of New Mexico that have yielded potash minerals in cuttings that contained 1.5 percent or more of $K_2O$.

The first known occurrence of sylvite in America was reported early in 1925 from a depth of 4,800 feet in the Gray No. 1 well, of the Rycade Oil Corporation, in the Markham salt dome, in Matagorda County, Tex. The first known occurrence of sylvite in New Mexico was found in the McNutt well, in Eddy County, and was announced by the Geological Survey April 3, 1926. The first core test in New Mexico showing potash was drilled by the Snowden McSweeney Co. near the site of the McNutt well. It disclosed 10 potash horizons of possible commercial interest, but at the depth of 988 feet there was a minable unit consisting of two layers of polyhalite with an intervening but separable bed of salt, in which there was 5 ft. 3 in. of polyhalite, averagaing 14.6 percent of $K_2O$. Sylvite, kainite, and langbeinite were also found in this well.

The general basin of Permian sediments and salts is known to be modified by subordinate folds which are being disclosed as oil drilling progresses. These folds not only serve as convenient traps for oil but they also bring potash salts nearer the surface and thus provide favorable places for potash exploration. The first selection of drilling sites for Government exploration was determined by these structures. It is not yet known, however, how the thickness of the potash beds at such places compares with the thickness in the deeper-lying structures. Some exploration of the deeper beds will therefore also be necessary.

The passage of potash legislation has revived interest in the saline lakes and playas of the Texas Panhandle region, and attempts are being made to organize companies ostensibly for the exploitation of the potash in these lakes. Since the brines of these lakes are generally poorer than those of Nebraska lakes, which have long since been inactive, there seems little likelihood that they can be of commercial interest.

There has also been a revival of interest in deposits of potassium or sodium nitrate in San Saba, Brewster, and Presidio Counties, Tex., and in parts of New Mexico and other states. Many of these deposits were examined by the Geological Survey during the late war or earlier. Although small amounts of high-grade salts were found at some of these places, in none of them was there enough to be mined on any sufficient scale. There seems, therefore, little probability that later discoveries of similar deposits will have commercial interest.

# CRUDE BARYTES ORE

## *Standards Of Preparation Improved—Ample Reserves Blocked Out To Last Twenty Years—Prosperity Of The Industry Dependent Only On Tariff*

*By* S. W. THOMPSON*

MINING and the preparation of non-metallic pigments for the various uses in manufacturing has advanced to a stage nearing perfection. This applies to the purity of the virgin deposits and then to the accuracy employed in preparing same for the manufacturers' use. This industry has kept pace with the trend of the times. In olden days there were named seven wonders of the world, and they remained as such for a long time, but we in modern days cease to count the wonders and accept such events as plain facts. Barytes has become one of the basic essentials for a variety of products and a discussion of the merits of this mineral will follow under the headings of: General Uses, Status of the Present Tonnage, Available Quantity in the United States, and Future of Barytes.

### GENERAL USES

Today barytes ore is used in making lithopone and the various barium salts, such as barium carbonate, barium chloride crystals, barium sulphate (blanc fixe), barium hydroxide, barium nitrate, barium sulphate (natural).

### STATUS OF PRESENT TONNAGE

As indicative of the steady growth of the mining and consumption of barytes, note the yearly tonnage from 1901 to 1926:

| Year | Short Tons | Year | Short Tons |
|---|---|---|---|
| 1901-15 (average) | 56,061 | 1921 | 66,369 |
| 1916 | 221,952 | 1922 | 155,040 |
| 1917 | 206,888 | 1923 | 214,183 |
| 1918 | 155,368 | 1924 | 196,332 |
| 1919 | 209,330 | 1925 | 228,063 |
| 1920 | 228,113 | 1926 | *248,000 |

*Approximate.

In 1925 the division of the quantity of crude ore was about as follows:

| | Tons |
|---|---|
| Lithopone | 146,693 |
| Ground barytes | 56,851 |
| Barium salts—combined | 29,141 |
| Total | 232,685 |

This tonnage was used in the United States, the State of Missouri producing about 44 percent of this amount, while Georgia and Tennessee produced all but 12,000 tons of the balance. Georgia produced, in 1924, 39 percent of the total output.

### AVAILABLE QUANTITY IN THE UNITED STATES

There are identified virgin deposits of crude barytes ore to last for 20 years at the present rate of extraction, and the States of Arizona, Nevada, New Mexico, California, Virginia, North Carolina each have ore bodies, some of which have been only partially surveyed, but represent a high-grade ore, and as the time approaches for the actual requirement of more ore, producing properties can be developed.

### FUTURE OF BARYTES

No one can gainsay the fact that the two industries, the crude ore producers and the converters or manufacturers of the raw material into its various finished commodities, are in enviable positions.

The source of supply is adequate. The raw material is mined and prepared to a high degree of uniformity, and like all well-regulated enterprises we must give quality and render service. Likewise the manufacturers of the various barium products have spent time and money, coupled with the highest ability, in the laboratory, to accomplish the ends they desired.

There are now about 30 manufacturers in the United States, many of whom have invested capital in million dollar amounts, and guided by past experience we can safely predict the continuance of our enterprises with one reservation. That is a higher protective tariff, both on raw material and the finished products. To disparage the expansion of our industries by an insufficient import duty on both crude barytes ore and all its derivatives seems unnecessary. We need attention in this vital matter and must have relief.

*Thompson, Weinman & Co., Inc., 52 Vanderbilt Avenue, New York City.

# DESTRUCTIVE DISTILLATION OF OIL SHALE

KNOWLEDGE of the chemistry of pyrolysis (breaking down by heat) and pyrogenesis (the formation by heat) of organic substances is being rapidly extended through the growing use of these principles in the cracking of oils and in the industries of coal distillation and gas manufacture, states the Bureau of Mines in a recently issued manual of testing methods for oil shale and shale oil. The thermochemical reactions in the destructive distillation (retorting) of oil shales are similar to those that occur in cracking oil and in carbonizing coal. The retorting of oil shale is similar to the low-temperature distillation of coal in that the products are a carbon residue containing a relatively high percentage of volatile matter, a small yield of gas, and a large yield of oil. High-temperature distillation of oil shale or coal gives a carbon residue having a low proportion of volatile matter, a large quantity of fixed gas, and a small quantity of oil. The oil produced by low-temperature distillation is much more easily refined to yield petroleum substitutes. The fixed carbon that remains in the spent shale corresponds to petroleum still-coke or to the coke from the carbonization of coal; the amount of volatile matter present in the coke is reduced as the temperature of distillation is raised.

The first action of heat on oil shale is the removal of the occluded gases that are present in small quantities. Also, in some shales low temperatures remove traces of light oil that may have been present as such or perhaps, prior to its decomposition, as resin or bitumen. As the temperature is raised, the organic matter of the shale decomposes and produces vapors which condense to form shale oil. Simultaneously, fixed gases are evolved. When the organic matter of the typical shale is heated, it changes first into a soluble bitumen and, as the heating continues, this bituminous substance further breaks down or "cracks" and forms shale oil. Whether all shales yield a bituminous substance of this kind as a primary decomposition product is not definitely known as yet. Some of the rich shales yield less bitumen than leaner shales when both are subjected to the same temperature and period of heating. A possible explanation of this paradox is that these richer shales produce a larger amount of bitumen that is less stable and therefore breaks down quickly into vapors and gases.

The Bureau of Mines has centered its experimental work largely upon the development of retorting conditions that will obtain from shales the largest yields of the desired products. In general, these products are those that can be substituted for petroleum products and can be made and refined with the smallest loss and by the simplest operations. The work done shows that the conditions which can be controlled easily during retorting—time, temperature and pressure—influence greatly the chemical and physical properties and the yields of the crude oils obtained from oil shales. The organic matter (kerogen) of the shales breaks down to form oils of higher quality when the retort temperature is low. Although most shales apparently begin to give off vapors at 300 to 375° C., these same shales will slowly decompose and yield oil at temperatures as low as 100 to 200° C. To retort the shales completely at such low temperatures, however, would require many hundreds of years.

Copies of Bulletin 249 "Manual of Testing Methods for Oil Shale and Shale Oil," may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

# BENTONITE

*Commercial Utilization Of Bentonite Has Progressed Slowly—Many Suggestions Have Been Made For Its Commercial Use, Some Of Which Are Still In An Embryonic Stage, But From Others Significant Tonnages Are Being Utilized*

By A. G. Van Eman *

BENTONITE was first mined in Wyoming near Rock Creek Station west of Laramie in 1888. The production was small and increased but slowly for a number of years, rising to 1,200 tons in 1902. Subsequently the production declined to but a few cars per year and little interest was taken in the material until six or seven years ago when the possibilities of this unusual clay attracted greater scientific attention. As a result, its commercial utilization has increased considerably. No figures are available for 1926 production of the type material but it is probable that nearly 4,000 tons were shipped during the year.

Bentonite was first described and classified in 1898 by W. C. Knight, who examined the material from the old Rock Creek Station deposit. It has since been found in many other localities, principally in Wyoming and South Dakota, though other deposits have been noted in Montana, Colorado and other states and in Canada.

The name bentonite was first used to designate the peculiar type of hyperplastic, highly absorptive clay found in the Benton formation in Wyoming and adjacent states. The classification has been broadened to include clays of like occurrence and composition not necessarily similar in colloidal properties. R. B. Ladoo[1] defines bentonite as: "A group or series of clay-like materials characterized by an alkaline oxide and alkaline earth content of 5 to 10 percent, fine grain size, high absorptive powers, and usually very strong colloidal properties." Bentonite is formed by the decomposition, in situ, of beds of transported volcanic ash. There seems to be evidence to support the theory that the highly colloidal varieties have been subjected to deflocculation by peptizing agents in solution subsequently to the original decomposition and hydration. It also seems evident that, in some cases at least, deflocculation has been prevented by the presence of dissolved electrolytes in sufficient concentration to effect coagulation.

Aside from articles on bentonite in the publications of the United States Geological Survey the references to bentonite in the literature are not plentiful. Until recent years very little of a comprehensive nature has been published.

The work of Hugh S. Spence[2] published in 1924 is undoubtedly the most complete to date. This bulletin contains an excellent bibliography of bentonite and related subjects. The reader is referred thereto for information regarding the composition, properties and behavior of bentonite.

The principal deposits of bentonite of the Wyoming type occur in Wyoming, South Dakota and in the Canadian provinces of Alberta and British Columbia. Deposits of bentonite of a different character, similar to and classified by some writers as Montniorillinoite, occur in large beds in California, Arizona and Nevada. Other deposits have been noted in Tennessee, Texas and Alabama.

The bentonites from different deposits vary greatly in colloidal properties. Some bentonites are practically non-colloidal[3] while others contain a large percentage of particles of colloidal dimensions.

## Uses

Though the commercial utilization of bentonite has progressed slowly its possibilities have attracted increasing scientific attention during recent years. Its peculiar properties have been found to have practical and advantageous application in a number of industries which its proponents had suggested as possible fields of utility. However, the development of bentonite as an industrial material is embryonic, as yet, though its application is steadily increasing. Industrial chemists are becoming more familiar with its peculiar properties and new progress is being made in development of new commercial uses. Among the many possible commercial uses for bentonite which have been suggested are: As an absorbent; in cements and plasters; in ceramics, as a bonding or plasticising[4] agent and as an agent for suspending enamels[5]; as a filler or loader; in paints, pastes and sizes; in soaps and detergents[6]; in foundry practice as a suspending agent for core washes and bonding agent in moulding sands; as a soil dressing and filler material for fertilizers; as a spreading or suspending agent for insecticidal sprays and dips; in pulp and paper as a co-agent with paper fillers to increase retention, as a suspending agent for carbon black in de-inking news print and as an emulsifier for pitch to prevent gumming; as an emulsifier for oils, asphalts[7], etc; and in pharmaceuticals. Bentonite of the California type has been extensively used, after acid treatment, in place of fullers earth for decolorizing oils and is said to be markedly more efficient.

Many of these suggested uses have been developed to a commercial stage and in some of them significant tonnages are being utilized. It is not to be expected that all attempts to use bentonite in the preparation of industrial products or materials will meet with success. The product is so new in industrial application that its properties are not yet fully understood or appreciated. Systematic technical experimentation is necessary, in most cases, in developing new applications; "rule of thumb" work with bentonite, as with most other industrial materials, will seldom yield results.

## Mining and Preparation

Bentonite deposits vary widely in character in different localities and even in different parts of the same deposit. In exploiting a deposit of bentonite particular care must always be given to the character of the clay in the deposit, to its economical extraction and to its subsequent preparation for industrial use. Attempts to dispose of run of mine clay or clay lacking in uniformity are not likely to meet with any measures of success.

From the standpoint of mining no new technology has been developed. Each deposit will, no doubt, have its peculiar problems which must be worked out.

The clay occurs in strata of varying thickness and dip, usually under and overlain with shale. In some places flat lying beds are exposed by erosion and may be of some extent without appreciable overburden, in other places the beds may dip steeply and necessitate underground mining. Deposits vary in thickness from a few inches to 12 or 15 feet and may vary greatly in sand and non-clay content.

The commercial development of a bentonite deposit demands careful consideration of the factors, transportation, quality, probable future market, development and the proper preparation of the clay for the exact requirements of that market. The writer can see no reason why the production of bentonite should not develop into an industry of considerable economic importance within a few years.

* Owyhee Chemical Products Co., Cheyenne, Wyo.

[1] Reports of Investigations, Serial No. 2289, Bureau of Mines, 1921.
[2] Hugh S. Spence, Bentonite, Canadian Department of Mines, Bulletin No. 626, 1924.
[3] J. Alexander, Colloid Symposium Monograph, Vol. 2, 1924.
[4] Paul E. Cox, J.AM. Ceramic Soc., 7, 151, 1924.
[5] M. E. Manson, Ibid., 6, 790, 1923.
[6] J. Alexander, Coll. Symposium Monograph, Vol. 2, 1924.
[7] L. Kirschbraun, U. S. Pat. 1,417,835, May 30, 1922.

# FOURTH ANNUAL CONVENTION PRACTICAL COAL OPERATING MEN

***Convention And Exposition Again Staged At Cincinnati—Program Committee Organized With Ezra Van Horn Chairman—Exposition Will Be Greatest Yet Held With More Than One Hundred Manufacturing Concerns Participating***

PLANS for the Fourth Annual Convention of Practical Operating Men and the National Exposition of Mine Equipment, to be held at Cincinnati, Ohio, during the week of May 16, are developing rapidly.

Ezra Van Horn, general manager, Clarkson Coal Company, Cleveland, Ohio, is chairman of the Program Committee. Those cooperating with him are as follows:

Hugh Shirkie, The American Mining Congress; Scott Turner, The U. S. Bureau of Mines; S. A. Taylor, The American Institute of Mining and Metallurgical Engineers; Walter Barnum, The National Coal Association; J. J. Rutledge, The Coal Mining Institute of America.

*Alabama*—F. S. Follansbee, Woodward Iron Co., Woodward, Ala.; Frank G. Morris, Republic Iron & Steel Co., Birmingham, Ala.; James Nicol, Jr., Galloway Coal Co., Carbon Hill, Ala.

*Colorado*—J. B. Marks, Colorado Fuel & Iron Co., Denver, Colo.; George T. Peart, Rocky Mountain Fuel Co., Denver, Colo.

*Illinois*—Geo. B. Harrington, Chicago, Wilmington & Franklin Coal Co., Chicago, Ill.; G. C. McFadden, Peabody Coal Co., Chicago, Ill.; J. D. Zook, O'Gara Coal Co., Chicago, Ill.; G. E. Lyman, Madison Coal Corporation, Glen Carbon, Ill.

*Indiana*—David Ingle, Ayershire Coal Co., Oakland City, Ind.; Carl J. Fletcher, Knox Coal Mining Co., Indianapolis, Ind.; Morton Gould, Linton Coal Co., Indianapolis, Ind.; P. L. Donie, Linton Coal Co., Linton, Ind.

*Kansas-Missouri*—John A. Sargent, Central Coal & Coke Co., Kansas City, Mo.; Frank Thomas, Clemens Coal Co., Pittsburg, Kans.

*Kentucky*—Sterling S. Lanier, Jr., Norton Coal Co., Nortonville, Ky.; C. W. Taylor, W. G. Duncan Coal Co., Greenville, Ky.; J. A. Helms, Fordson Coal Co., Stone, Ky.; F. J. O'Connell, Wisconsin Steel Co., Benham, Ky.; T. E. Jenkins, West Kentucky Coal Co., Sturgis, Ky.

*Montana*—J. F. Lobdell, Eagle Coal Co., Red Lodge, Mont.; F. V. H. Collins, Bair-Collins Co., Roundup, Mont.

*New Mexico*—W. D. Brennan, Stag Canyon Fuel Co., Dawson, N. Mex.; Frank A. Young, St. Louis Rocky Mountain & Pacific Coal Co., Raton, N. Mex.

*Ohio*—O. S. Newton, Sunday Creek Coal Co., Columbus, Ohio; Ezra Van Horn, Clarkson Coal Co., Cleveland, Ohio.

*Ezra Van Horn, Chairman of the Program Committee. Mr. Van Horn is General Manager of the Clarkson Coal Co., of Cleveland*

*Pennsylvania*—F. G. Wilcox, West End Coal Co., Scranton, Pa.; Geo. F. Osler, Pittsburgh Terminal Coal Co., Pittsburgh, Pa.; A. B. Kelley, Humphreys Coal & Coke Co., Greensburg, Pa.; A. W. Hesse, Buckeye Coal Co., Nemacolin, Pa.; R. H. Buchanan, Hudson Coal Co., Scranton, Pa.; J. B. Warriner, Cranberry Creek Coal Co., Lansford, Pa.; L. E. Young, Pittsburgh Coal Co., Pittsburgh, Pa.; T. R. Vinton, Rochester & Pittsburgh Coal Co., Indiana, Pa.; Newell G. Alford, Union Trust Bldg., Pittsburgh, Pa.; E. J. Newbaker, Berwind White Coal Co., Windber, Pa.

*Tennessee*—John L. Boyd, Proctor Coal Co., Knoxville, Tenn.; W. B. Young, Bon Air Coal & Iron Co., Bon Air, Tenn.

*Utah*—D. D. Muir, Jr., United States S. R. & M., Salt Lake City, Utah.

*Virginia*—H. S. Estill, Stonega Coke & Coal Corporation, Big Stone Gap, Va.; D. Terpstra, Premier Red Ash Coal Co., Red Ash, Va.; J. D. Martin, Virginia Iron, Coal & Coke Co., Roanoke, Va.; George Craft, Pocahontas Fuel Co., Pocahontas, Va.

*Washington*—N. D. Moore, Pacific Coast Coal Co., Seattle, Wash.; E. F. Lucas, Bellingham Coal Mines, Bellingham, Wash.

*West Virginia*—Thos. DeVenny, Portsmouth By-Product Coke Co., Edgarton, W. Va.; Edward Graff, New River Coal Co., Macdonald, W. Va.; A. R. Beisel, Island Creek Coal Co., Huntington, W. Va.

*Wyoming*—Eugene McAuliffe, Union Facific Coal Co., Rock Springs, Wyo.; Gomer Reese, Kemmerer Coal Interests, Kemmerer, Wyo.

*Cooperating Coal Associations*—E. W. Parker, Anthracite Bureau of Information, Philadelphia, Pa.; W. E. E. Koepler, Pocahontas Operators' Association, Bluefield, W. Va.; D. C. Kennedy, Kanawha Coal Operators' Association, Charleston, W. Va.; C. E. McLaughlin, Coal Operators' Association of Illinois, Chicago, Ill.; C. H. Mead, Winding Gulf Operators' Association, Beckley, W. Va.; P. H. Penna, Indiana Bituminous Coal Operators' Association, Terre Haute, Ind.; C. J. Neekamp, Northeast Kentucky Coal Association, Ashland, Ky.; W. L. Johnson, S. W. Interstate Coal Operators' Association, Kansas City, Mo.; E. J. McVann, Smokeless Coal Operators' Association, Washington, D. C.; Harry L. Gandy, National Coal Association, Washington, D. C.

A preliminary meeting of the committee was held at the offices of the American Mining Congress, Washington, D. C., February 11, at which it was determined that three sessions of the convention would be devoted to discussion of coal preparation, three sessions to mechanical loading problems, one session to mine safety, and one session to cutting and blasting problems. The tenta-

tive program, as outlined, includes papers on:

COAL PREPARATION

Recent Developments and Necessity for Coal Preparation; Economical Methods of Eliminating Impurities in Preparation of Anthracite Coal; The Sand Flotation Process for Cleaning Coal (both anthracite and bituminous); Cleaning Both Anthracite and Bituminous Coal by the Launder System; Cleaning Small Size Anthracite and Bituminous Coals; The Dry Cleaning of Coal (papers on this subject covering Pennsylvania, West Virginia and Far West coal districts); Preparing Coal by the Table Washing Method; Preparation and Marketing of Crop Line and Off-grade Coals ,anthracite and bituminous); Effect of Coal Cleaning on its Marketability.

MECHANICAL LOADING

Recent Developments in Mechanical Loading; Four Related Factors in Mechanized Mining; Cutting and Sheering, Transportation, Roof Control, Preparation; Longwall With Conveyors; Room and Pillar with Conveyors; Pillar Recovery with Conveyors; Modified Longwall with Scrapers; Entry Driving with Mechanical Loaders; One Hundred Percent Mechanical Mining; Mechanical Operation Following a Definite Mining Projection; Developing and Operating with Mechanical Loaders; Handling Dirt Bands with Mechanical Loaders.

SAFETY IN COAL PRODUCTION

Safety Features of Mechanical Mining, Best Means to Keep Accident Prevention Before the Men; When and How to Unseal Mine Fires; Handling Gases Through Proper Ventilation.

CUTTING AND BLASTING

Blasting Coal with Carbonic Acid Gas; Under What Conditions Should Top Cutters and Bottom Cutters Be Used; Comparison of Results Obtained by Top and Bottom Cutters; Use of Explosives in Undercutting; Cutting.

The exposition, which has yearly become increasingly important, promises to be an outstanding one. At this writing (February 25) seventy-nine manufacturers have contracted for approximately 90 percent of the total available space. Those who have so far definitely contracted for exhibit space are:

Ahlberg Bearing Co., 317 East 29th St., Chicago, Ill., space 108; Allen & Garcia Co., Chicago, Ill., space 85; American Car & Foundry Co., Huntington, W. Va., space 38-39 and 46-57; American Rheolaveur Co., Wilkes-Barre, Pa., space 83-84; Atlas Powder Co., Wilmington, Del., space 48; Bethlehem Steel Co. (Geo. A. Richardson, manager), Technical Publicity Dept., Bethlehem, Pa., space 36-37; Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa., space 114-115-116; Chicago Pneumatic Tool Co., East 44th St., New York, N. Y., space 29-30; Coal Mine Equipment Co., Pittsburgh, Pa., space being selected; Coloder Co., Columbus, Ohio, space 101; Concordia Electric Co., 916 Forbes St., Pittsburgh, Pa., space 200.

Deister Concentrator Co., Ft. Wayne, Ind., space 62; Dravo-Doyle Co., Dravo Bldg., Pittsburgh, Pa., space 2-3; Deming Co., Salem, Ohio, space 10; Duff Manufacturing Co., Pittsburgh, Pa., space being decided; Eagle Iron Works, Des Moines, Iowa, space 9; Edison Storage Battery Co., Orange, N. J., space 42-43; E. I. du Pont de Nemours & Co., Wilmington, Del., space 69; Electric Railway Equipment Co., 2900 Gormandy Ave., Cincinnati, Ohio, space 8; Electric Railway Improvement Co., 2070 East 61st Place, Cleveland, Ohio, space 66; Electric Storage Battery Co., Philadelphia, Pa., space 27-28; Fairbanks Morse & Co., 900 S. Wabash Ave., Chicago, Ill., space 89-90; Fort Pitt Mine Equipment Co., Pittsburgh, Pa., space 92; Frederick Iron & Steel Co., Frederick, Md., space 120; General Electric Co., Schenectady, N. Y., space 11-12-13-14; Goodman Manufacturing Co., Halstead St. & 48th Place, Chicago, Ill., space 77-78.

Hockensmith Wheel & Mine Car Co., Penn, Pa., space 70; Hendrick Manufacturing Co., Carbondale, Pa., space 72; Hercules Powder Co., Wilmington, Del., space 5; Hulburt Oil & Grease Co., Trenton & Erie Sts., Philadelphia, Pa., space 67; Hyatt Roller Bearing Co., Newark, N. J., space 52-53; Hydrotator Co., New York, space being decided; Jeffrey Manufacturing Co., 974 North 4th St., Columbus, Ohio, space 49-50-51; Joy Manufacturing Co., Franklin, Pa., space 64; Keystone Lubricating Co., Philadelphia, Pa., space 78-79; Koehler Manufacturing Co., Marlboro, Mass., space 31; A. Leschen & Sons Rope Co., St. Louis, Mo., space 102-103; Lincoln Steel & Forge Co., St. Louis, Mo., space 57-58; Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., space 44; Lorain Steel Co., Johnstown, Pa., space 109-113 (inclusive).

Mancha Storage Battery Locomotive Co., 1909 S. Kingshighway, St. Louis, Mo., space 32; McCullough Engineering Co., H. C., Pittsburgh, Pa., space 65; McGraw Hill Co., New York, N. Y., space 117-118; Mine Safety Appliances Co., Braddock Ave. & Thomas Blvd., Pittsburgh, Pa., space 119; Mining Congress Journal, lobby; Mining Safety Device Co., Bowerston, Ohio, space 68; Morgan Gardner Electric Co., Harvey, Ill., space 91; Murray Pump & Valve Manufacturing Co., New Lexington, Ohio., space 100; Myers-Whaley Co., Inc., Knoxville, Tenn., space 59 (tent.); National Carbon Co., Cleveland, Ohio, space 6; R. D. Nuttall Co., McCandless Ave. & Harrison St., Pittsburgh, Pa., space 15; Ohio Brass Co., Mansfield, Ohio, space 40-45; Osborne Register Co., 123 West Pearl St., Cincinnati, Ohio., space 104; Phillips Mine and Mill Supply Co., Pittsburgh, Pa., space 7; Post Glover Electric Co., Cincinnati, Ohio., space 121; Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill., space 4; Robinson Ventilating Co., Jenkins Arcade Bldg., Pittsburgh, Pa., space 97; John A. Roebling's Sons Co., Trenton, N. J., space 71; Rome Wire Co., Rome, N. Y., space 88; Simons Paint Spray Brush Co., 17 Maryland Ave., Dayton, Ohio, space 105; Simplex Wire & Cable Co., 15 So. Des Plaines St., Chicago, Ill., space 75 (tent.); S. K. F. Industries, 165 Broadway, New York City, space 86-87; Streeter-Amet Weighing & Recording Co., 4101-4105 Ravenswood Ave., Chicago, Ill, space 1.

Templeton Kenley & Co., Ltd., 1020 So. Central Ave., Chicago, Ill., space 54; Timken Roller Bearing Co., Canton, Ohio, space 76; Tool Steel Gear & Pinion Co., Cincinnati, Ohio, space 83; W. S. Tyler Co., 3615 Superior Ave., Cleveland, Ohio, space 34-35; Una Welding & Bonding Co., Cleveland, Ohio, space 55; Watt Car & Wheel Co., Barnesville, Ohio, space 81; Waverly Oil Works Co., Pittsburgh, Pa., space 56; Weir Kilby Corporation, Cincinnati, Ohio, space 74-75-82; Westinghouse Electric & Manufacturing Co., E. Pittsburgh, Pa., space 15-19 (inclusive); West Virginia Rail Co., Huntington, W. Va., space 41.

It is important to note that the 90 percent includes forty-one spaces located in South Hall, which the demand for space has made necessary. During that past three years the exposition has been confined exclusively to North Hall, the convention session being held in the Auditorium which connects North and South Halls. The acoustic properties of the Auditorium have never been satisfactory. To overcome this situation the convention management has arranged with the management of the Music Hall to build an auditorium in South Hall, the balance of the hall being utilized by exhibits.

Special arrangements are being made for entertainment for the delegates. This entertainment will be entirely different from that of previous years, and will add materially to the success of the event.

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Jesse Holder, of the Holder Coal Co., of Lynn, Mass., has been made president of the newly-organized North Shore Coal Exchange, which held its first formal meeting in Salem, Mass., recently. William M. Shaw, of Reed & Costello, of Lynn, is secretary-treasurer. The cities represented in the organization include Lynn, Salem, Swampscott, Marblehead, Peabody, Danvers, Beverly and Gloucester. Headquarters will be at Lynn.

# COAL

## PRACTICAL OPERATING MEN'S DEPARTMENT

NEWELL G. ALFORD, Editor

*Practical Operating Problems of the Coal Mining Industry*

# METALLURGICAL COAL WASHING PLANT OF AMERICAN SMELTING & REFINING COMPANY AT COKEDALE, COLORADO

*A Discussion Of The Problems Involved In Washing Western Coking Coal Together With A Brief Description Of The Rheolaveur Plant Used For Doing This Work—Peculiarities Of This Coal Makes Washing Very Difficult*

*By* MICHAEL WALLE* *and* GUY V. WOODY†

THE Bon Carbo Colliery of the American Smelting & Refining Co. is part of the Trinidad Coal Field in the so-called Mesa Region north of the Raton Field. The coal from this mine presents certain peculiarities which are very interesting and which make the washing of this coal one of the most difficult in this country.

The geologic age of the coal is the lower Cretaceous, which would give a sub-bituminous or lignitic coal had no metamorphism taken place in the region. The stratigraphic condition is that of an almost horizontal deposit, so that no dynamic metamorphism due to bending pressures has taken place. The mountain range, which divides the Raton and the Trinidad Region into two coal fields, is also the border line between New Mexico and Colorado and is of volcanic origin, the layers being in their original horizontal stratification and the scenery, therefore, showing the typical table formation.

The Bon Carbo coal would be a very good coking coal, as it comes from the mine, were it not for its high ash content and it is for this reason, therefore, that washing is necessary. The amount of ash in the mine run coal varies from 16 to 20 percent, the volatile matter in the pure coal is around 33 percent and the sulphur varies from .6 to .8 percent.

*Research Engineer, American Rheolaveur Corp.
†General Manager, American Rheolaveur Corp.

The physical appearance of this coal is, however, not at all similar to that of a coal having the same volatile matter content but originating from the Carboniferous strata and submitted to a Hercynien Bending with the strong dynamic metamorphism of bending pressure and temperature. In general, the Bon Carbo coal has no definite crystalline texture, is very friable and the very fine coal is amorphous or pulverulent.

The shale, bone and coal are so finely banded that it is necessary to crush the mine coal to pass through a 5/16-in. (8 mm.) screen in order to free them sufficiently so that washed coal of sufficiently low ash can be obtained with a high recovery.

The rock which is present in the mine run coal in a relatively small proportion is also very easily pulverized, being of a very soft nature, the cement between the grains of the original clay not having had the time to harden and not having been sufficiently affected by the local metamorphism due to the intrusions of lavas. These conditions, together with the argillaceous composition of the rock (shale or slate), act in such a way that when put into water the shale will easily return to the original state of clay and the finest portion of it will be held in the state of a colloidal suspension.

The bone is almost entirely composed of laminated material, rock and coal being alternately stuck to each other. The lightest part of the bone has the same appearance as that of the pure coal and is only different in its ash content, and its specific gravity is only slightly different than that of the purest coal. There is a considerable amount of bone in the

***Interest in mine mechanization has been steadily growing. Leaders in the coal industry are keeping in close touch with the situation. They realize that mechanization, if not here today, is but around the corner.***

***Mr. G. B. Southward, Consulting Engineer, has been engaged by The American Mining Congress to make a complete investigation of the adoption of mining and loading equipment by the industry. There are already a sufficient number of successful installations of mechanical equipment to prove that it is not only successful, but the next logical step in economical coal production.***

***It is our belief that the information which Mr. Southward will secure will be of inestimable value to the coal industry. Had some of the earlier users of mechanical equipment been in possession of such facts as his reports will show, they would have saved thousands of dollars.***

*The Editors.*

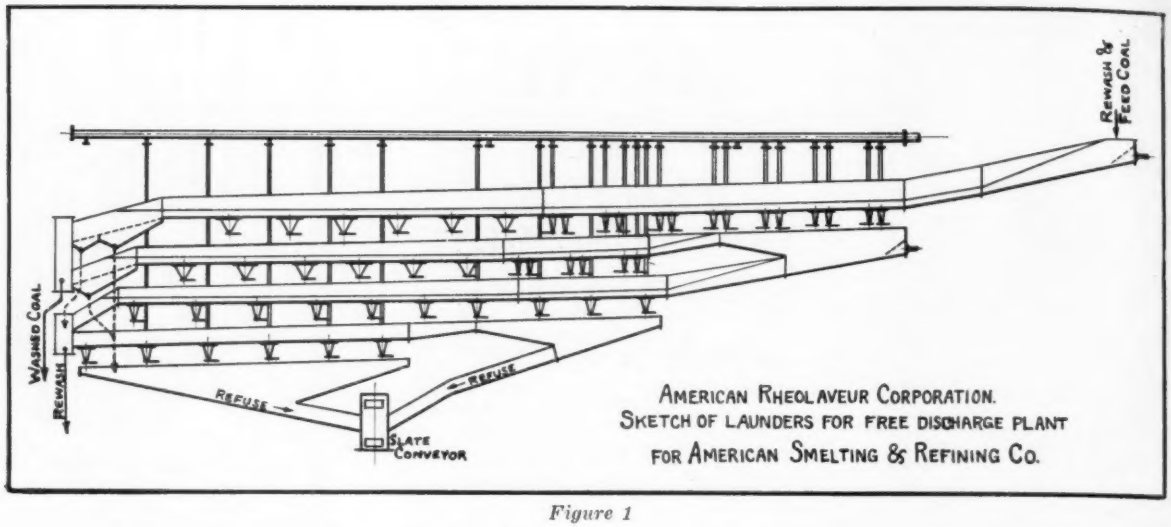



*Figure 1*

run-of-mine coal. In general it is harder than the purer coal or the purer rock. This fact is easily understood when it is noted that in the laminated portion of the bone the lines of cleavage are different in the two components. A good example of this same phenomenon is that of a certain kind of psammite rock formed of fine interstratified sandstone and slate, which is very hard and is sometimes used for the paving of roads.

The above facts, as well as some others which will be noted in the examination of the characteristics of the feed coal from the washability curves, will be mentioned later in this paper when discussing the characteristics of this coal with reference to crushing and washing.

The very fine feed coal passing through a 48 Tyler standard mesh screen has a rubbery consistency when wet with water, this probably being due first to the very fine rock and second to the amorphous state of the very fine pure coal. This fact will be recalled when discussing the washing of the fine coal and its action in a thickener.

The proportion of the fines passing 48 mesh is particularly high in the feed coal, averaging about 15 percent and being largely occasioned by the fact that it is necessary to crush all the material so that it will pass through a 5/16-in. (8 mm.) screen.

TABLE I
SCREEN AND ASH ANALYSES OF RAW FEED TO RHEOLAVEUR PLANT
Weighted Average of One Week's Operation

| Screen Size | | | | Size Test Weight Percent | Size Test Cumulative Weight Percent | Ash Percent Each Size | Ash Percent Cumulative |
|---|---|---|---|---|---|---|---|
| | Plus | 5/16" | Rd. | 0.17 | 0.17 | 28.8 | 28.8 |
| Minus 5/16" | Plus | ¼" | Rd. | 2.63 | 2.80 | 16.5 | 17.2 |
| Minus ¼" | Plus | ⅛" | Rd. | 23.20 | 26.00 | 17.0 | 17.0 |
| Minus ¼" | Plus | 14 | Mesh | 30.40 | 56.40 | 16.5 | 16.7 |
| Minus 14 | Plus | 48 | Mesh | 28.10 | 84.50 | 16.0 | 16.5 |
| Minus 48 | Plus | 100 | Mesh | 7.76 | 92.26 | 19.7 | 16.8 |
| Minus 100 | Plus | 200 | Mesh | 3.87 | 96.13 | 21.5 | 17.0 |
| Minus 200 | Mesh | | | 3.87 | 100.00 | 22.6 | 17.2 |

## Washing Plant

The Bon Carbo mine itself is located several miles from the washing plant, which washing plant is adjacent to the coking plant. The coal from the mine is sent to a tipple with screens and a portion of the larger sized coal is cleaned by hand and sent to the domestic fuel market. That coal which is not sent to market is shipped in standard gauge, hopper bottom, railroad cars to the washing plant. The coal is dumped into a track hopper and from this hopper passes through a preliminary crusher which crushes it down to approximately 1½-in. and smaller. From this crusher it is delivered onto a belt conveyor and elevated into a large raw coal storage pocket. The feed coal from this pocket is conveyed by belt conveyor over an automatic scale onto a large shaking screen fitted with 5/16-in. (8 mm.) wire mesh. The oversize from the screen passes into an American Ring crusher with bars set at ⅜-in. (9.5 mm.). This gives a product passing through the screen and from the crusher to the plant feed pocket of approximately 0 to 5/16-in. with comparatively small amount of oversize.

From the feed pocket the coal is fed into the top of the Rheolaveur plant by a table type rotary feeder with a raw coal sampling device in continuous operation.

The plant itself is of the free discharge type designed for washing 0 to 5/16-in. (8 mm.) feed material. In this particular instance it is made up of four launders arranged one over the other. That material passing from the end of the top two launders is the washed coal, that

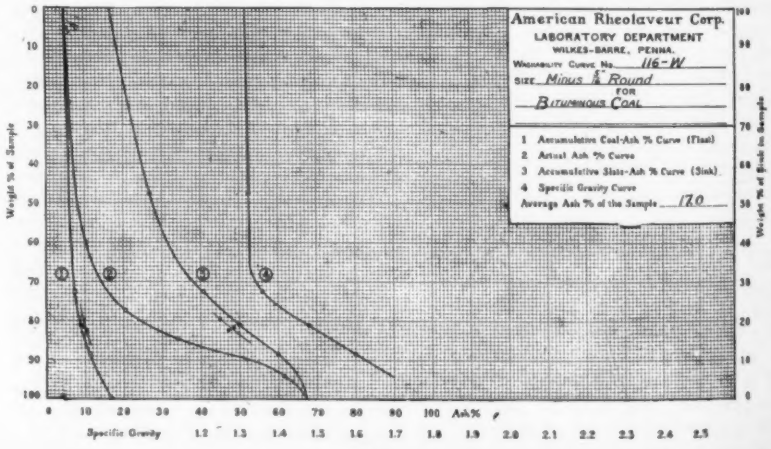



*Figure 2*

passing over the end of the next two launders is the rewash material and the refuse material passes out of the Rheo boxes on the bottom two launders into a slate trough and thence into a dewatering conveyor.

Some of the Rheo boxes, which are extending from the bottom of all the launders for evacuation of material (coal, bone or refuse) are arranged for upward flow currents. The boxes arranged for use with water generally evacuate a course material, either bone or slate, while the boxes having no water connections are used for evacuating the finer material.

At the end of the top two launders, wedge wire screens are installed in the bottom so as to eliminate from the washed coal the very fine material which has not been thoroughly and completely washed. Some of this material, after passing through the first wedge wire screen, is discharged with its water into the refuse, while other material passing through the second part of wedge wire screen is discharged into the rewash launder and again passes through the plant. The first part of screen is 1/10 mm. and the second is ¼ mm.

The regulating or rewash material which passes over the end of No. 3 and No. 4 launders is led by a trough to a dewatering scraper conveyor and returned into the top of No. 1 launder to be rewashed with the feed material. The washed coal passes into a washed coal dewatering conveyor and is conveyed to the washed coal pockets.

A word of description regarding the three dewatering conveyors is in order here. They are so designed that at the bottom end they run horizontal for a distance of from 6 to 10 feet. In the bottom of the conveyor pit and on the bottom of the conveyor pans, there is ranged at intervals ¼ mm. (0.01-in.) wedge wire screens, the opening in the screen running parallel to the direction of the movement of the conveyor. The conveyor flights are fitted with rubber wipers, which keep each of the wedge wire screens clean and allow some of the material below ¼ mm. together with the free water to pass through these screens. The material and water which pass through the wedge wire dewatering screens on the rewash conveyor and the washed coal conveyor, pass back into a pump sump, from which it is pumped to a 70-ft. diameter Dorr thickener. The material and water passing through the wedge wire dewatering screens on the refuse conveyor are discharged into an open stream and lost. This amounts to about 120 G. P. M. containing 1.21 percent solids and the solids analyze from 48 to 66 percent ash.

The water and material from the sump, which are pumped into the Dorr thick-

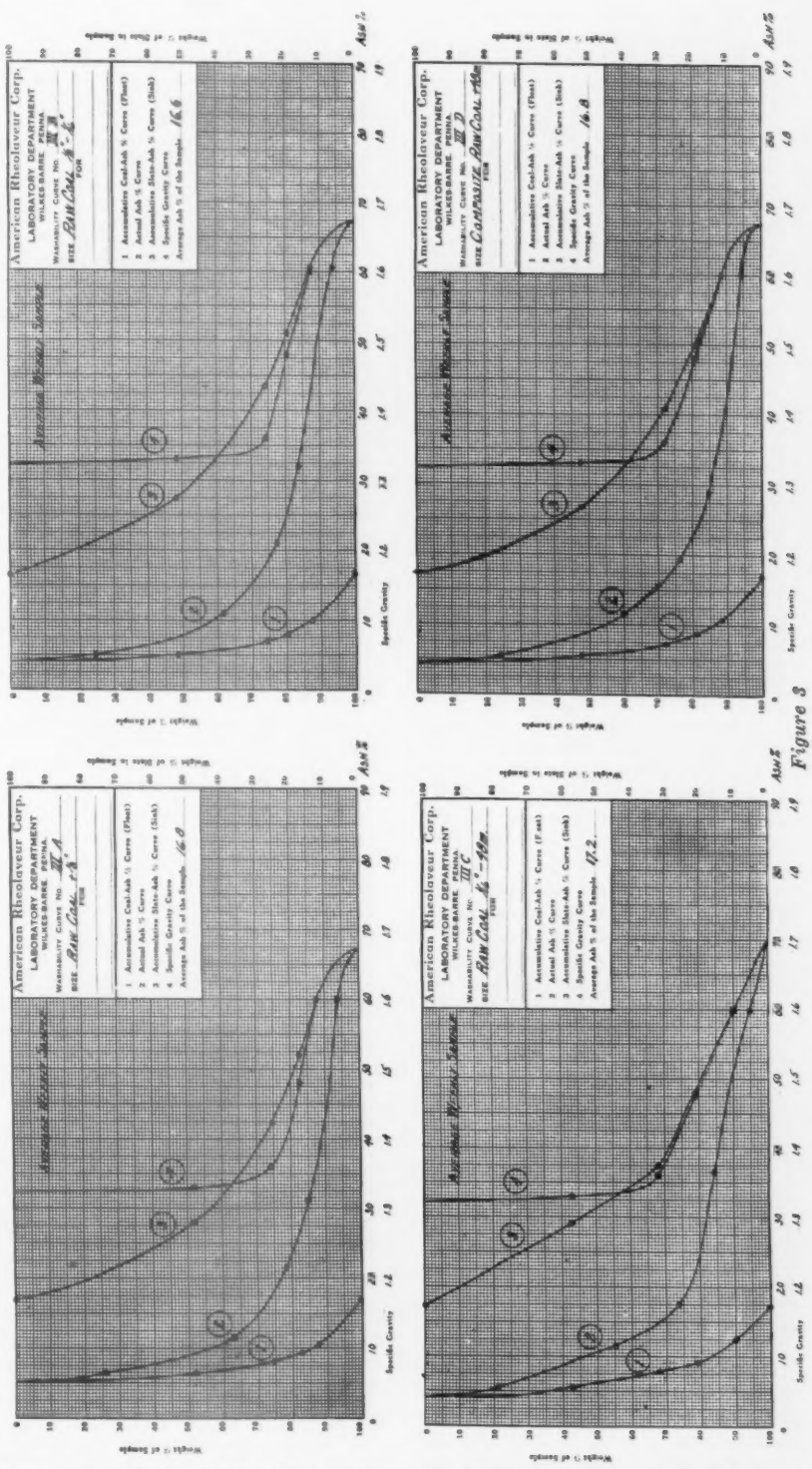



Figure 3

ener, are settled and the settled product is taken out of the thickener by a Dorrco pump and discharged back into the top of No. 1 launder in the main washing plant, mixing with the feed coal and the rewash material. The overflow from the thickener is used for push and upward flow currents in the washing plant.

It is always very interesting to know beforehand if possible what results can be expected from a plant designed to wash a given coal. In some instances test plants have been installed to try to obtain such results. It has been found, however, that a test plant may be built for washing a certain kind of coal and that very accurate results can be obtained, but that this test plant will not give the same accuracy on another kind of coal. Therefore, means have been de-

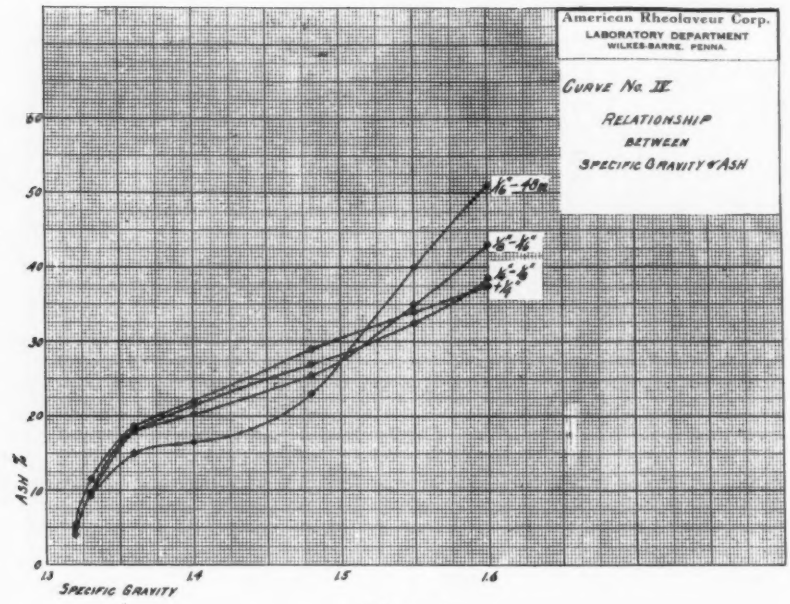



*Figure 4*

vised to make washability curves and check these washability curves with actual washery results.

Figure 2 shows a washability curve of an average weekly feed at this plant and on this washability curve are indicated results actually obtained in washing. Table II is a tabulation of the actual washing results shown on the above curve, giving also the theoretical ash in the washed coal and refuse indicated by the curve at the recovery actually obtained. The washing results of the plant with varying ash in the feed have been corrected so far as recovery is concerned to 17 percent ash feed coal, which is covered by the washability curve.

**TABLE II.**

| | Recovery Percent | Washed Coal Ash % Actual Plant Washing | Washed Coal Ash % Theoretical From Curve | Refuse Ash % Actual Plant Washing | Refuse Ash % Theoretical From Curve |
|---|---|---|---|---|---|
| Dec. 1 to 15, 1926.. | 82.2 | 10.51 | 9.5 | 47.30 | 51.7 |
| Dec. 16 to 31, 1926.. | 79.5 | 9.94 | 9.0 | 45.00 | 48.0 |
| Jan. 1 to 15, 1927.. | 81.6 | 9.94 | 9.4 | 48.70 | 50.8 |
| Jan. 16 to 23, 1927.. | 83.0 | 10.40 | 9.6 | 49.64 | 53.1 |

It will be noted that all of the actual washed coal results are within 1 percent of the ash content required by the washability curve at a given recovery and, therefore, demonstrate that close and accurate predictions can be made as to washing results after testing a carefully taken representative sample of the raw coal sized as it will be washed. It is also of interest to note that the results in the later periods approach nearer to the theoretical results and indicate improvement in the plant as the result of knowledge and experience on the part of the operators.

Washability studies on the sample of feed coal submitted before the plant was designed indicated a recovery of 78 percent with washed coal at 10.8 percent ash and refuse at 48 percent ash. An average of all the washing in this plant since the first period of adjustment shows a recovery of 80 percent with washed coal at 10.47 percent and refuse at 47.85 percent ash, which shows a considerably better performance than was originally promised.

With the automatic sampler an average daily sample of the feed coal is obtained. The weekly sample is made up by mixing an amount of the daily sample proportionate to the actual washed coal tonnage for the day in question. After quartering down, the average sample is very representative of a week's run. This average sample is then sized into the following sizes:

5/16-in. to ⅛-in.; ⅛-in. to 1/16-in.; 1/16-in. to 48 mesh; 48 mesh to 0.

On each of the above sizes, excepting 48 mesh to 0, a complete set of float and sink tests and washability curves is made. These are shown under Figure 3—A, B and C respectively. Figure 3—D is a composite washability curve made on the plus 48 mesh material.

Figure 4 is a graph showing the relation between ash and specific gravity for the different size of material in the feed.

From an examination of Figure 4, it can be noted that the material lighter than 1.36 sp. gr. is of a different nature than that having a specific gravity heavier than 1.36, i. e., the first part is of relatively constant specific gravity with relatively high variation in ash, while the latter shows a constant relationship between ash and specific gravity. This characteristic of the curve indicates that the Bon Carbo coal can be washed very easily at a washing gravity safely above 1.36 sp. gr., but that near to 1.36 sp. gr. washing will be more difficult and the results more variable due to the fact that the float in the refuse will be much lower in ash, as shown by Figue 3. In the actual operation of the plant this fact was very noticeable and information was obtained from another plant washing the same kind of coal confirming the above peculiarity. At the Cokedale plant, therefore, the above indicates that washing at 11 percent ash and above is very much easier and more stable than when producing a washed coal under this content.

**TABLE III**

| Test No. | | Average Ash % | Size of Material: Plus 1/16" Weight in % | Plus 1/16" Ash % | Minus 1/16" Plus 48 Mesh Weight in % | Minus 1/16" Plus 48 Mesh Ash % | Minus 48 Mesh Weight in % | Minus 48 Mesh Ash % |
|---|---|---|---|---|---|---|---|---|
| | Feed coal | 17.8 | 56.5 | 17.5 | 28.7 | 17.0 | 14.8 | 18.5 |
| I | Washed coal | 9.3 | 56.8 | 9.0 | 29.0 | 10.2 | 13.6 | 17.2 |
| | Washed refuse | 48.5 | 77.9 | 49.1 | 21.0 | 47.0 | 1.1 | 49.1 |
| | Feed coal | 18.0 | 59.8 | 18.2 | 28.2 | 18.1 | 12.0 | 20.6 |
| II | Washed coal | 10.7 | 70.7 | 10.1 | 20.4 | 10.5 | 8.8 | 18.2 |
| | Washed refuse | 48.1 | 83.2 | 49.7 | 15.8 | 46.0 | 9.8 | 46.2 |
| | Feed coal | 18.8 | 69.6 | 17.1 | 21.3 | 18.7 | 9.1 | 20.7 |
| III | Washed coal | 10.5 | 64.0 | 9.4 | 24.9 | 10.8 | 11.1 | 16.7 |
| | Washed refuse | 49.3 | 87.6 | 48.2 | 11.5 | 48.3 | 0.9 | 47.1 |
| | Feed coal | 20.0 | 56.2 | 21.2 | 27.7 | 20.1 | 16.1 | 20.0 |
| IV | Washed coal | 11.7 | 57.5 | 10.6 | 28.5 | 12.2 | 14.0 | 19.2 |
| | Washed refuse | 51.0 | 79.0 | 50.5 | 19.6 | 52.7 | 1.4 | 48.7 |
| | Feed coal | 19.0 | 64.4 | 17.4 | 24.4 | 18.7 | 11.2 | 20.6 |
| V | Washed coal | 10.3 | 67.6 | 8.8 | 23.4 | 10.0 | 9.0 | 16.8 |
| | Washed refuse | 45.5 | 83.6 | 45.4 | 15.7 | 46.2 | 0.8 | 48.2 |
| | Feed coal | 18.7 | 58.8 | 18.9 | 27.0 | 18.1 | 14.2 | 19.8 |
| VI | Washed coal | 11.0 | 67.1 | 9.0 | 22.8 | 11.0 | 10.1 | 17.1 |
| | Washed refuse | 51.4 | 84.0 | 51.5 | 15.4 | 50.4 | 0.6 | 46.9 |
| | Feed coal | 17.7 | 54.3 | 18.2 | 29.8 | 18.0 | 15.9 | 19.0 |
| VII | Washed coal | 10.3 | 56.6 | 9.3 | 30.3 | 10.3 | 13.1 | 15.5 |
| | Washed refuse | 47.3 | 80.3 | 49.7 | 18.8 | 47.2 | 0.9 | 43.4 |
| | Feed coal | 18.0 | 65.0 | 17.5 | 23.8 | 17.7 | 11.2 | 19.2 |
| VIII | Washed coal | 10.5 | 63.5 | 9.0 | 24.6 | 10.0 | 11.9 | 16.3 |
| | Washed refuse | 51.5 | 79.2 | 52.0 | 19.8 | 50.0 | 1.0 | 49.2 |

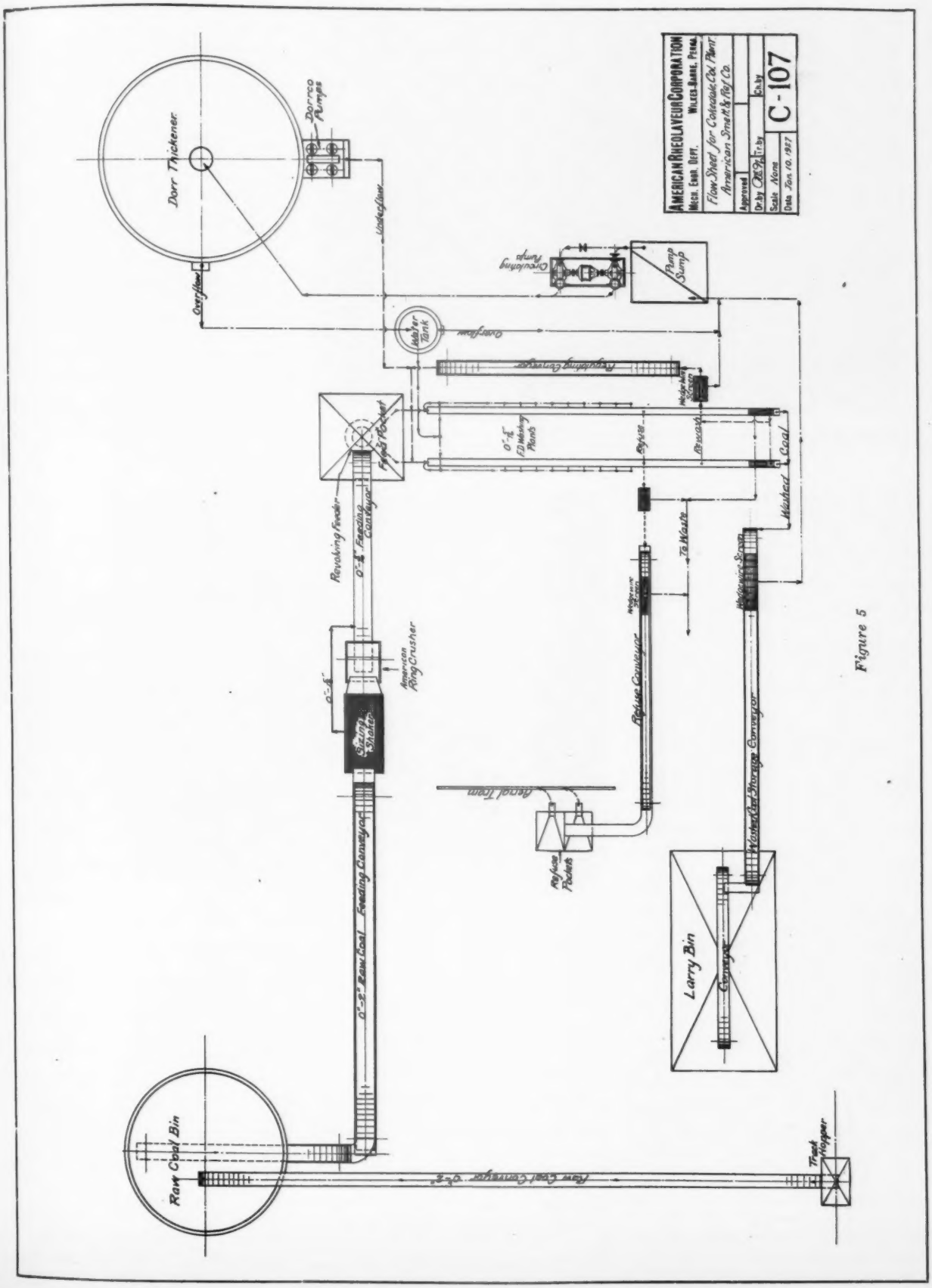

AMERICAN RHEOLAVEUR CORPORATION
Mech. Engr. Dept. WILKES-BARRE, PENNA.
Flow Sheet for Coketon Coke Plant
American Smelting & Ref. Co.
Approved
Dr. by
Ch. by
Scale None
Date Jan. 10, 1927
C-107
Dorr Thickener
Dorrco Pumps
Overflow
Underflow
Diverting Pump
Pump Sump
Water Tank
Overflow
Revolving Screen
Refuse
Breach
Washed Coal
To Waste
Revolving Feeder
0'-8" Feeding Conveyor
American Ring Crusher
Swing Shaker
Refuse Conveyor
Washed Coal Storage Conveyor
Refuse Pockets
Larry Bin
Conveyor
Raw Coal Bin
0'-8" Raw Coal Feeding Conveyor
Raw Coal Conveyor 0'-8"
Track Hopper

Figure 5

*Track hopper and raw coal conveyor with washed coal and refuse conveyors from Rheolaveur plant in background, Cokedale Washery*

The specific gravity of the lightest and heaviest material encountered in the feed product, together with the specific gravity of the washing solution, i. e., the pulp of fine solids in suspension in the water, indicates that it might be possible to wash at a size ratio of 20 to 1, providing a state of hindered settling can be produced. In the actual operation it was shown that we could wash satisfactorily from 5/16-in. in size down to 48 mesh (0.295 mm.), or a diameter ratio of about 20 to 1.

**TABLE OF FIGURED RECOVERIES**

| Test No. | On the Whole Material | Plus 1/16" | Minus 1/16" Plus 48 Mesh | Minus 48 Mesh |
|---|---|---|---|---|
| I | 81.2 | 78.9 | 81.5 | 93 0 |
| II | 80.6 | 79.5 | 78.6 | 91.3 |
| III | 80.8 | 80.2 | 78.8 | 86.8 |
| IV | 79.0 | 78.5 | 80.5 | 97.4 |
| V | 77.5 | 76.5 | 76.0 | 88.0 |
| VI | 81.0 | 76.8 | 82.0 | 91.0 |
| VII | 80.0 | 78.0 | 79.1 | 87.5 |
| VIII | 81.6 | 80.2 | 80.7 | 91.3 |

From the test results, it will be noted that the coal is washed as completely as possible down to approximately 48 mesh material and that the refuse is washed down to 0.

From Table III it is seen that the quantity of rock extracted from the 0 to 48 mesh material is small, and this explains the high average recovery. If an attempt were made to wash the 0 to 48 mesh material down to 10 percent ash and the sizes above 48 mesh were washed down to an ash content so that the average would be the same as noted in the above table, then the yield or recovery would not have been so good as shown. The point being made is that it was found best to wash the plus 48 mesh material to a low ash, only reducing slightly in ash the minus 48 mesh material and obtaining an average low ash washed coal with the best yield possible and a refuse having about the same ash content in all sizes.

The crushing of the coal at first presented some difficulty, due to the fact that no real texture existed in the coal. Adjustments to the crusher were made after the above fact was discovered and some considerable improvement was obtained. However, it is certain that more fines were obtained by putting the larger coal into the crusher than was the proportion of the fines in the natural coal. It was noted several times that where the coal from the large raw feed pockets was coarser than usual and, therefore, more of it was fed to the crusher, the amount of fines coming from the feed pocket to the washing plant was greatly increased.

Figure 5 is a flow sheet of the plant at Cokedale. The coal, after being washed in the plant, is delivered, as stated above, to large washed coal bins, where it is allowed to drain over a period of from 24 to 36 hours and then drawn off into charging larries and sent to the beehive coke ovens adjacent. The normal ash in the washed coal varies from 9.5 to 10.5 percent and this corresponds to 14 to 15 percent of ash in the coke. On account of the very large amount of fines which are washed in the Rheolaveur plant, the coke obtained from the washed coal has a very good structure, and the amount of braize from the ovens is very materially reduced.

Table IV shows a comparison between the weighed and figured recoveries.

The capacity of one Rheolaveur free discharge unit washing the Cokedale coal with the very large percentage of fines, as indicated in sizing table I, is approximately 40 tons per hour, and the amount of water used in circulation to wash this coal is from 900 to 1,000 G. P. M., or between 5½ to 6¼ tons of water per ton of coal. The comparatively small capacity of this set of launders is occasioned by the large per-

*Washing plant showing feed conveyor in center background and washed coal and refuse conveyors housing, Cokedale Washery*

**TABLE IV**

| Day | Tonnage | Figured Recovery | Figured R x T. | Weighed Recovery | Weighed R x T. |
|---|---|---|---|---|---|
| First ... | 244.5 | 81.0 | 198 | 80.2 | 196 |
| Second .. | 304.0 | 85.0 | 258 | 77.2 | 234 |
| Third ... | 283.5 | 80.0 | 226 | 82.1 | 234 |
| Fourth .. | 312.1 | 83.4 | 260 | 82.0 | 256 |
| Fifth ... | 328.5 | 81.2 | 266 | 81.8 | 268 |
| Sixth .. | 322.2 | 83.2 | 268 | 82.3 | 265 |
| Seventh.. | 219.2 | 83.2 | 182 | 87.4 | 191 |
| | 2,014.0 | | 1,658 | | 1,844 |
| Average . | | 82.5 | | 81.8 | |

(R. x T.—Recovery x Tonnage.)

centage of fines in this feed coal. Ordinarily this set of launders would have a capacity of 60 to 80 tons per hour of minus ⅜-in or 5/16-in. feed, i. e., a feed having about 50 percent plus ⅛-in., 75 or 80 percent of plus 14 mesh and only 5 to 7 percent of minus 48 mesh.

Two men are required for the operation of the washing plant itself. A third man is used on the washed coal and refuse conveyor to distribute the coal to the various bins and the fourth man is required to operate the thickener and the feed apparatus to the plant. It is very probable that in ordinary operation this last-mentioned man would not be required, but careful watch over the thickening apparatus is thought advisable here because of the large percentage of fines which are handled. Assuming a rate of $5 per day for the washery men, the daily labor cost is $20.

The amount of power taken by the plant at the present time, if compared on the horsepower-per-ton basis, is high, because all of the power units and machinery have been installed for the ultimate capacity of approximately 120 tons per hour. A list of the amount of power installed, exclusive of the main conveyor from the track hopper to the feed bins follows:

| | H.P. |
|---|---|
| Raw coal conveyor from bin to shaker and crusher | 25 |
| Crusher | 75 |
| Raw coal conveyor from shaker and crusher to feed pocket | 10 |
| Feeder | 2 |
| Rewash conveyor | 15 |
| Washed coal and refuse conveyors | 75 |
| Pump | 100 |
| Dorr thickener | 10 |
| Total | 312 |

The power units in the washing plant only, not including the preliminary preparation machinery, are as follows:

| | H.P. |
|---|---|
| Feeder | 2 |
| Rewash conveyor | 15 |
| Washed coal and refuse conveyors | 75 |
| Pump | 100 |
| Total | 192 |

Assuming that all motors are loaded to 85 percent of rated capacity and operate nine hours per day at a charge of 2 cents per K. W. H., then the power charge would be $24.40 per day.

While it would be possible to arrive at the total first cost of the plant in question, this figure would not be of any particular interest relative to other washing plants. Some of the equipment in the previous jig and table plant was used, and the plant was installed in an existing building. However, with the changes which were made in order to fit this apparatus into the other plant layout, it is doubtful whether any money was saved over what it would have cost to build a new plant, but since one location was available, and it was necessary to have uninterrupted operation, the plant was built in this manner.

For purposes of arriving at a washing cost, therefore, it would be safe to assume a total plant cost of $150,000, not including in this cost the raw coal or washed coal bins. It is also estimated that for the completed plant two men will be required in addition to the four now used on the washing plant. The power requirements will not exceed those previously mentioned.

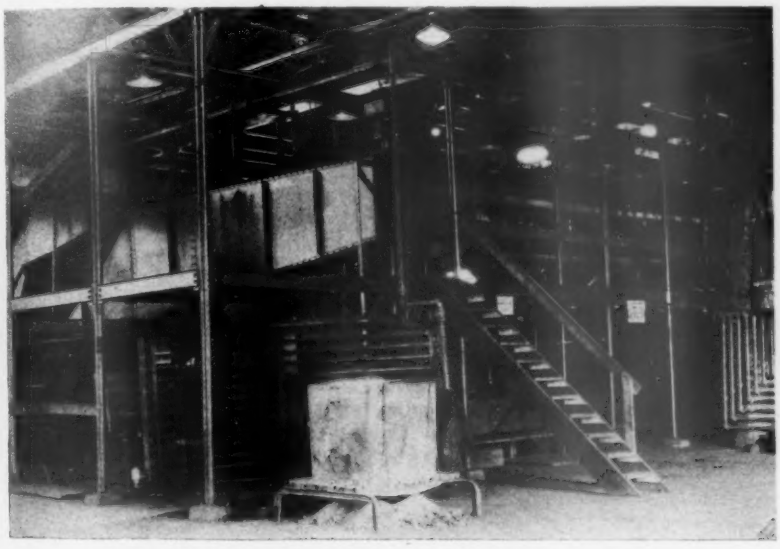
Based on these figures, we arrive at the following washing costs:

| | |
|---|---|
| Depreciation at 5 percent with money reinvested at 4 percent, which would mean value of complete depreciation in 14 years | $7,500.00 |
| Maintenance, repairs and insurance—5 percent | 7,500.00 |
| Labor cost—6 men, $5 per day, 300 days a year | 9,000.00 |
| Power cost—$24.40 per day, 300 days a year | 7,320.00 |
| Total | $31,320.00 |
| **Washing Capacity:** | |
| 120 tons per hour, 9 hours per day, 300 days a year ..... tons.. | 324,000 |
| Cost per ton of washing ..... cents.. | 9.6 |

The Rheolaveur plant at this colliery was designed and built under the supervision of Allen & Garcia Co., consulting engineers, Chicago, Ill., and from them a considerable amount of the information as given above has been obtained.

The daily tests and results are made under the direction of Mr. H. H. Bubb, superintendent of the Cokedale Plant of the American Smelting & Refining Co.

*Free discharge plant, showing chute for washed coal in upper left corner, chute for rewash in lower left corner, and chute for refuse at bottom, Cokedale Washery*



*Another view of the free discharge plant, Cokedale Washery*

# SAND FLOTATION INSTALLATIONS AT GRAND TUNNEL COAL COMPANY AND ROSE COAL COMPANY

*Grand Tunnel Coal Co., Has Used Sand Flotation Over A Period Of Five Years During Which Time Their Percentage Of Prepared Sizes Increased From 65 to 76.6 Percent—Refuse Is Subjected To About Ten Tests Each Day—Splendid Record Also At Rose Company*

*By* JAS. T. SWEENEY*

THE companies with which I am connected—that is, the Grand Tunnel Coal Co., West Nanticoke, Pa., and the Rose Coal Co., Winton-Peckville, Pa.—made the first two commercial installations of the Chance sand flotation process for cleaning coal in the anthracite region. At least the installation for the Grand Tunnel Coal Co. was the first commercial plant erected, and that for the Rose Coal Co. was, I believe, the second to be placed in operation, although other installations building at the same time may have been undertaken some time in advance of it.

The installation at the Grand Tunnel Coal Co.'s breaker in West Nanticoke was intended and has been used principally for the preparation of fresh-mined coal, although at the outset a very considerable quantity of refuse bank was prepared by this plant and from time to time since then bank material has been prepared by it. On the other hand, the Rose Coal Co. plant at Winton was erected primarily for the handling of refuse bank material and has been used chiefly for this purpose, although at various times fresh-mined coal has been prepared by it. In the following remarks I will, therefore, refer to these two plants separately.

### GRAND TUNNEL COAL CO.

In 1921 the Grand Tunnel Coal Co. had a monthly output of about 6,000 tons and was preparing this in a breaker that had been built some time before and was equipped with the usual machinery, consisting of shaking screens, jigs, etc. We were at that time endeavoring to handle some bank material along with our fresh-mined output. The results obtained from the breaker were not satisfactory. Extensive tests were conducted to determine just what these results were and reference to reports of these tests shows them to be as follows when the plant was operating on fresh-mined coal alone:

| Operating Results on Fresh-Mined Coal—Old Breaker 1921 | |
|---|---|
| Prepared sizes (egg, stove, nut).... | 65% |
| Steam sizes (pea, buck, birdeye).... | 35% |
| Average impurities prepared sizes shipped ..... | 4% Slate<br>2½% Bone |
| Average impurities steam sizes shipped ..... | 6% Slate |
| Average loss of coal and bone with refuse ..... | 12% (Plus) |

In the spring of 1921 we arranged with Mr. T. M. Chance for the installation of equipment to clean our coal by the process of sand flotation. The installation decided upon consisted of one 7-ft. 9-in. diameter cone with the required accessory apparatus. This was located in an addition on the easterly side of our old breaker about 14 ft. by 20 ft. in plan and 50 ft. high. The mine-run coal was led to it by existing screens in the old breaker, and after passing through the cleaner and over the sizing shakers installed in connection with it, was taken back into the storage pockets of the old building. This installation was, of course, made under the personal supervision of Mr. Chance, and, after certain necessary experimental work by him, was turned over to us in the summer of 1921. It has been used by us since that time in its completed form without any essential alteration and without replacement of any of the larger and more important elements. Parts subject to wear, such as pump parts, refuse conveyor chain and flights, and piping have, of course, been replaced from time to time as necessary, but, in general, the original equipment remains complete and intact and shows every evidence of continuing so indefinitely.

One addition to this equipment was made by us in the summer of 1924. The original installation was designed and intended to handle only the larger or prepared sizes of coal and at the outset was operated by us on this basis. We had in our old breaker the jigs with which it was equipped, and we utilized these for the preparation of buckwheat and birdseye. The upkeep of the old plant, however, became burdensome, and from time to time additional tonnage of the small sizes was diverted to the cleaner, and we found that it handled all sizes from egg to birdseye, inclusive, satisfactorily. By 1924, however, our output had grown from 6,000 to about 20,000 tons per month, and in order to handle this increased tonnage of all sizes, including the steam sizes, we at that time installed an auxiliary overflow cone for the preparation of buckwheat and birdseye. With this addition, we have for the past several years prepared our entire output of 20,000 tons monthly through the cleaner with a force of five men inside the breaker and roll-house.

Operating results obtained by us at Grand Tunnel Coal Co. are indicated by the following figures: For the six months immediately following resumption of operations in February, 1926, our percentage of prepared sizes was 76.6 average for the period and ran as high as 79.24

*Grand Tunnel Coal Company, West Nanticoke, Pa.*

* Scranton, Pa.

percent prior to our closing the main rolls in order to limit the production of egg size. During the same six-month period the average output of the cleaner per breaker hour was 72.2 tons. For a good many hours during this time the output of the cleaner was in excess of 100 tons per hour. It will be noted that our present average percentage of prepared sizes, amounting to 76.6, compares with 65 percent average prepared sizes obtained from the old breaker in use by us in 1921 prior to the installation of the cleaner. We choose to think that our mining practice and general breaker practice have improved during this interval and are responsible for a certain part of this increase in prepared yield, but must state that the major portion, if not very nearly all of this increase, is due to the much shorter and direct course our coal now takes through the cleaner equipment, with the consequent reduction in breakage and the elimination of rehandling because of unsatisfactory preparation.

### Preparation Results

All our coal produced at West Nanticoke is carefully inspected and tested as it is loaded. The tabulation given below covers the three-month period, July, August and September, 1926. Tests in the number shown were taken on each size, and the average of all these tests is as set down under percent of slate, percent of bone, percent of ash, etc. The percent of ash in the steam sizes is, in every case, determined by the usual laboratory combustion test:

**Summary of Tests Showing Impurities in Coal Shipped During the Three Months of 1926**

| Size | No. Tests Taken | Percent Slate | Percent Bone | Combustion Test |
|---|---|---|---|---|
| Egg ..... | 161 | 1.514 | 2.48 | |
| Nut ..... | 214 | 2.79 | 3.157 | |
| Stove ..... | 274 | 1.305 | 2.132 | |
| Pea ..... | 50 | | | 12.34% of Ash |
| Buck ..... | 87 | | | 12.01% of Ash |
| Birdseye .. | 92 | | | 17.85% of Ash |
| Average .. ... | | 1.85 | 2.56 | 14.35% of Ash |

It should be stated here that during a portion of the three months covered by the tests given above we were taking into the breaker, in addition to our regular mine coal, material from three separate refuse banks on neighboring properties, and in spite of this admixture of this waste material containing, as it did, very high percentages of slate and bone, we noticed comparatively little effect on the character of either our coal or refuse. However, had the tests reported above covered a period of operation on fresh-mined alone, I do not doubt that they would show even more favorable results in regard to the elimination of impurities from coal shipments.

The refuse from our cleaner is also tested at frequent intervals during each day, so that not less than 10 tests of the refuse are made daily. These tests, supplementing the usual visual inspection, are made in a Delatester by means of a solution of zinc chloride maintained at 1.75 specific gravity. During the same period of three months covered by the tests of coal as given above, 747 separate tests were made on the refuse passing through our cleaner to the refuse bank. The refuse thus tested consists of all sizes from egg to birdseye (rice and barley mixed), inclusive, and the average of these 747 tests shows that 1½ percent of the total amount of refuse consisted of salable material (coal and bone). Attention is called to the fact that these tests were made on a specific gravity of 1.75. This constitutes a classification of salable material as that containing 35 percent ash or less. If these tests were made on a lower gravity, as, for instance, 1.70, corresponding to a classification of salable material as that containing 30 percent ash or less, the amount of salable material in our refuse would be much less than the 1½ percent shown.

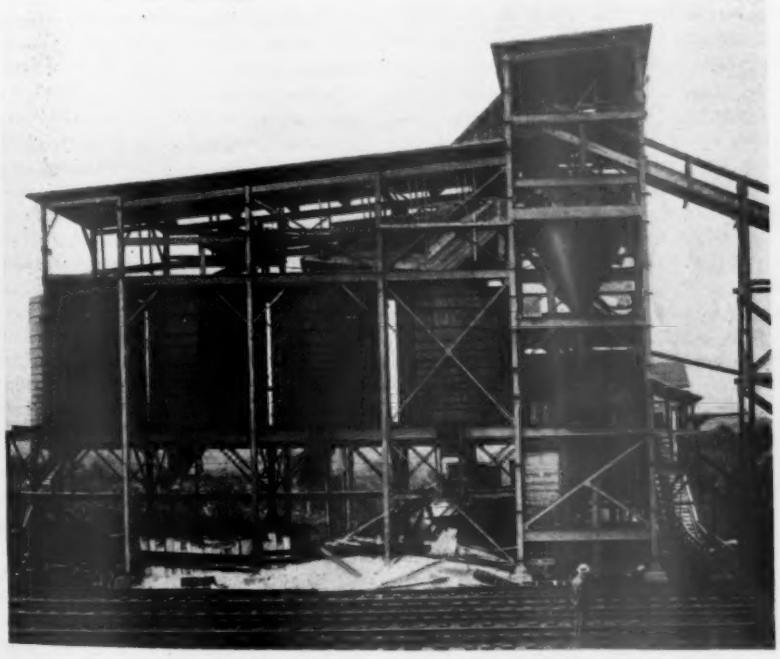
Since the refuse at the Grand Tunnel Coal Co. averages 15 percent of the total material taken into the breaker, it will be noted that for the period of three months covered by the figures given above 99.78 percent of the coal brought to the breaker was shipped to market.

Due to the extremely clean character of the coal shipped from our operation, as indicated by the figures given above, we are able to secure a substantially higher price for our entire annual output of 250,000 tons than is secured by other operations in the same field which do not employ the same method of preparation, and in view of this fact, in addition to the increase of 11.6 points, or 18 percent, in percentage of prepared sizes, and the reduction of at least 10½ points, or 90 percent, of salable material sent to waste, as well as accompanying reduction in costs, we feel that our cleaner has been eminently satisfactory and a highly profitable investment.

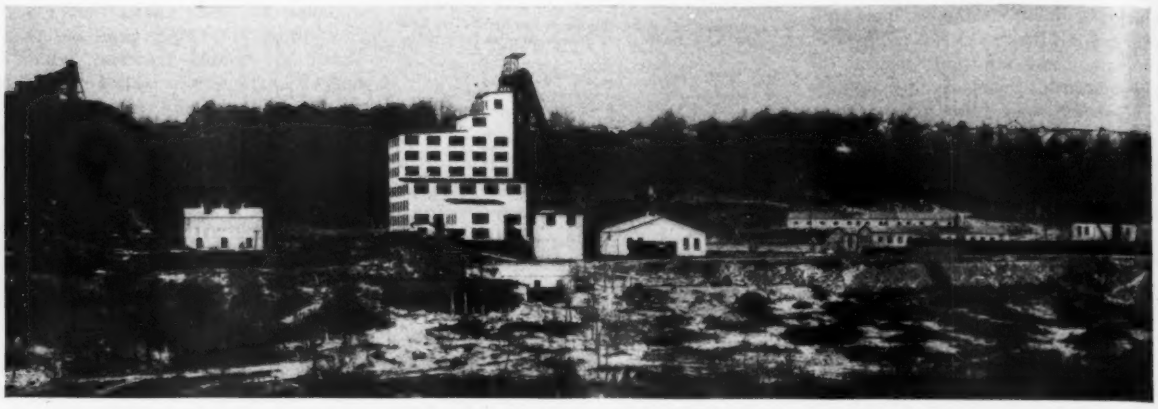
### Rose Coal Co.

Shortly after the installation referred to above was made for the Grand Tunnel Coal Co., the Rose Coal Co. erected a plant at Winton, comprising one 15-foot Chance cone, primarily with the idea of retreating jig refuse banks from nearby operations in order to secure therefrom the good coal which it was felt these banks contained. During one period of 15 months we ran through this plant 242,000 tons of jig refuse, and shipped therefrom 39,129 tons of anthracite coal of excellent quality. It will be noted that this shows a recovery of 16 percent of the raw feed. The material fed to our plant during this period was the waste product from a breaker built in 1913 equipped with jigs. As is plainly shown by the figures given above, this material was of a character that the usual type of preparation plant can not rehandle and turn out a product that can be guaranteed as to quality.

As each railroad car was loaded, its contents was tested for ash and the ash content of the coal was guaranteed. Because of this separate ash analysis of the contents of each car, the usual inspection for slate and bone was not made, and because we were (*Continued on page* 245)



*Rose Coal Company, Winton-Peckville, Pa.*



*The Colonial Breaker of Madeira, Hill & Company, Natalie, Pa.*

# SAND FLOTATION PROCESS IN ITS APPLICATION TO CLEANING ANTHRACITE

***Through This Plant The Company Has Been Able To Increase Its Prepared Sizes Approximately Three And One-Half Percent—In Addition To The Use Of Sand Flotation, They Have Eliminated Coal Pockets And Installed Loading Booms***

*By* E. H. SUENDER*

THE constantly rising demand from the consuming public for better and better quality and service; the trade war for the public's light, heat and power business between electric, oil, gas, coke, bituminous and anthracite coal industries; the expenditure of millions in advertising, to carry the merits of product and service to the consumer, makes it necessary to serve the public with a super-prepared fuel that is so highly satisfactory, that in turn a demand will be created for it. In its efforts to better serve a critical public, the anthracite industry has never failed to take advantage of every known improvement tending toward increased efficiency in production as well as quality of product.

The consumer is not interested in the purchasers' or manufacturers' problems, intricate as they are, and even unsolvable as they sometimes seem to be. He rightfully demands service, and unless it is forthcoming looks elsewhere for it, and usually gets it.

Industries of long standing thus disappear, sometimes with remarkable suddenness. Price, quality, service—one or all of these may be the reason.

The preparation of anthracite from its very beginning was one of manufacture, with added problems, caused by changing conditions in the quality of the raw product, the ever-increasing costs, due to factors so well known in the mining industry, and the interference in the business by political cure-alls, with good and sometimes bad motives, clamoring for changes; with little knowledge, and sometimes without regard for the effect that the change may impose upon producer and consumer.

About a century ago, when anthracite was first marketed, only the purest and thickest of veins were mined, and only the larger sizes were salable, i. e., the product passing through about ¾-in square mesh was sent to the refuse banks.

At that time the only method of preparation was that of hand picking the refuse from the larger sizes, crushing the coal and screening it for domestic and other commercial purposes.

In time markets were developed for the smaller sizes, the preparation of which made the use of mechanical devices for extracting refuse a necessity, and the efficiency of these machines in turn resulted in a further expansion of markets for the trade sizes of pea, buckwheat (buck No. 1), rice (buck No. 2), barley (buck No. 3), and finally buckwheat (No. 4).

Pea coal made through 11/16-in. round mesh and over ½-in. round mesh was first marketed about 60 years ago. Buckwheat made through ½-in. round and over ¼-in round mesh was first marketed about 50 years ago. Rice coal made through ¼-in. round mesh and over 3/16-in. round mesh was first marketed about 40 years ago. Barley coal made through 3/16-in. round mesh and over 1/16-in. round mesh was first marketed about 25 years ago. The size smaller than barley, i. e., the size passing through 1/16-in. round mesh (buckwheat No. 4) was first used commercially about 20 years ago, and there is only a limited market for this size today.

The business of mining, preparing and shipping anthracite was in the beginning conducted by individuals or small corporations, many of whom were not financially able to take advantage of improvements and machinery that was available from time to time. They, therefore, could not rob first mined areas beyond the point where the mixture of refuse with the coal made it impossible to prepare the product for market in the absence of needed and available mechanical devices. Excessive waste was the final result, and much of this waste can not now be reclaimed.

Let us look back to the conditions that then existed. There was a frightful waste of a valuable product found in an area of less than 500 square miles in northeastern Pennsylvania, or about one-tenth of one percent of the bituminous acreage in the United States, the market for which expanded quite rapidly up to recent years, total shipments approximating three billion tons, or more than 20 percent of the total shipments of anthracite and bituminous in the United States, and still contributing about 13 percent of the total coal consumed. In view of this, it is most fortunate that the properties eventually fell into stronger hands, who foresaw the necessity for conserving the limited product, and for applying the most improved methods in mining and preparing the coal to suit the needs of a more exacting consumer.

Unlike most manufacturing problems, where the unit costs, following wage increases and shorter working hours, are

* General Manager, Madeira, Hill & Company's anthracite operations.

often reflected in lower costs as the result of plant betterments for improved methods of operation, the industry today finds it a seemingly unsolvable problem to offset the constantly rising cost of mining and preparing coal through improvement expenditures.

The pumping of 11 tons of water per ton of coal produced; the circulation of 2 tons of air per minute into the mines for ventilation, per ton of coal produced; the annual use of 500,000,000 board feet of timber, or 7 feet per ton of coal produced; the extraction of one-half ton of refuse for every ton of coal shipped; the extension of mine workings, deep as well as lateral; and the resulting increasing pumping and hoisting heads, together with the additional equipment for given capacities, gives some idea of the problem that the industry is confronted with.

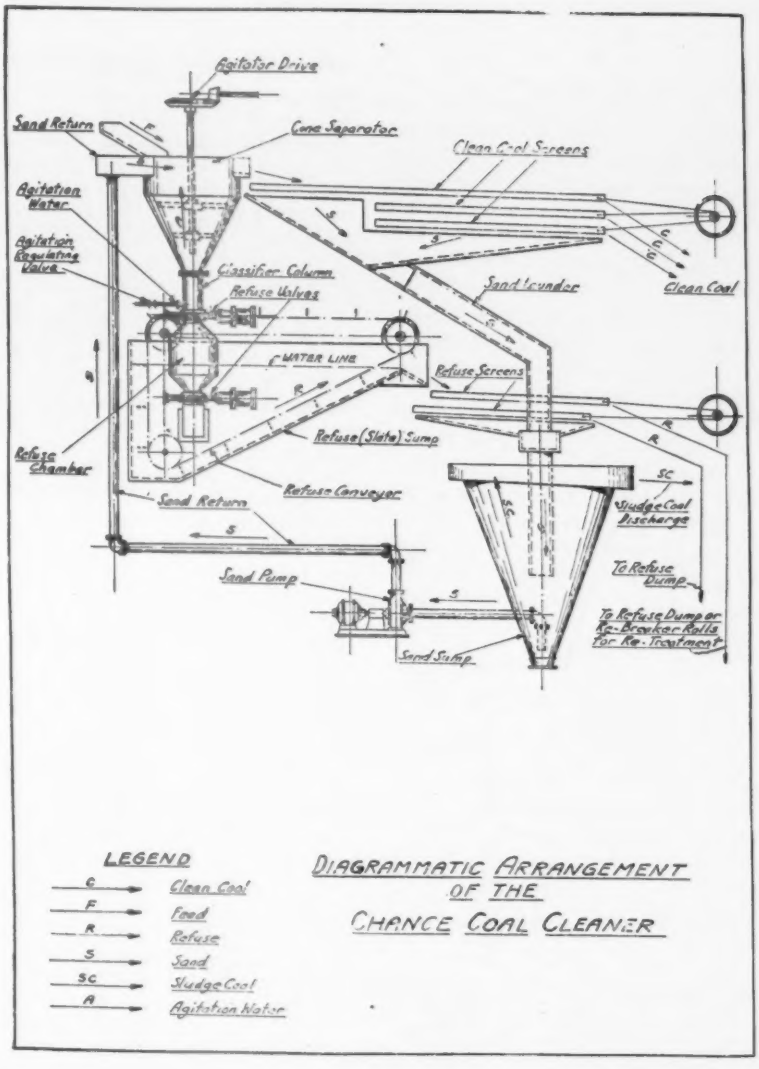
The process of manufacturing the run-of-mine product into a commercial article which started with hand picking only, is today largely accomplished with the use of jigs of numerous types, which have been improved from time to time, constantly with the thought in mind of preparing a product of greater value to the consumer, with less waste to the bank and with the maximum percentage of the prepared or more expensive size.

The conservation of the remaining tonnage in the ground, necessitating the robbing and re-robbing of old workings and the mining of thinner and dirtier seams of coal, which only a few years ago were considered unmineable; the ever-increasing cost, and the strike of the public against these high costs, have added increasing problems for the industry to solve.

The already low return on the capital invested by the industry as a whole, as reflected in the report of the United States Coal Commission, makes it more imperative than ever to take advantage of every known device to cheapen costs, and at the same time to serve the public with a more satisfactory article.

The jig method of separating refuse from coal, which is almost in universal use throughout the field, while giving good results, is far from fool-proof, and some types result in considerable breakage. Jig separation of coal and refuse depends largely upon the character of the material, the difference in gravity between the coal, bone and refuse, the fracture of the coal and slate, and the degree of careful sizing before the material enters the jigs—the best practice being obtained from the more uniform size material.

Not many years ago a refuse bank from a jig breaker, particularly in the southern field, that contained not over 5 percent to 6 percent coal was considered fair; a bank containing as low as 4 percent was considered good. Today a refuse bank containing as much as 5 percent is considered bad, and a bank containing less than 3 percent is considered good.

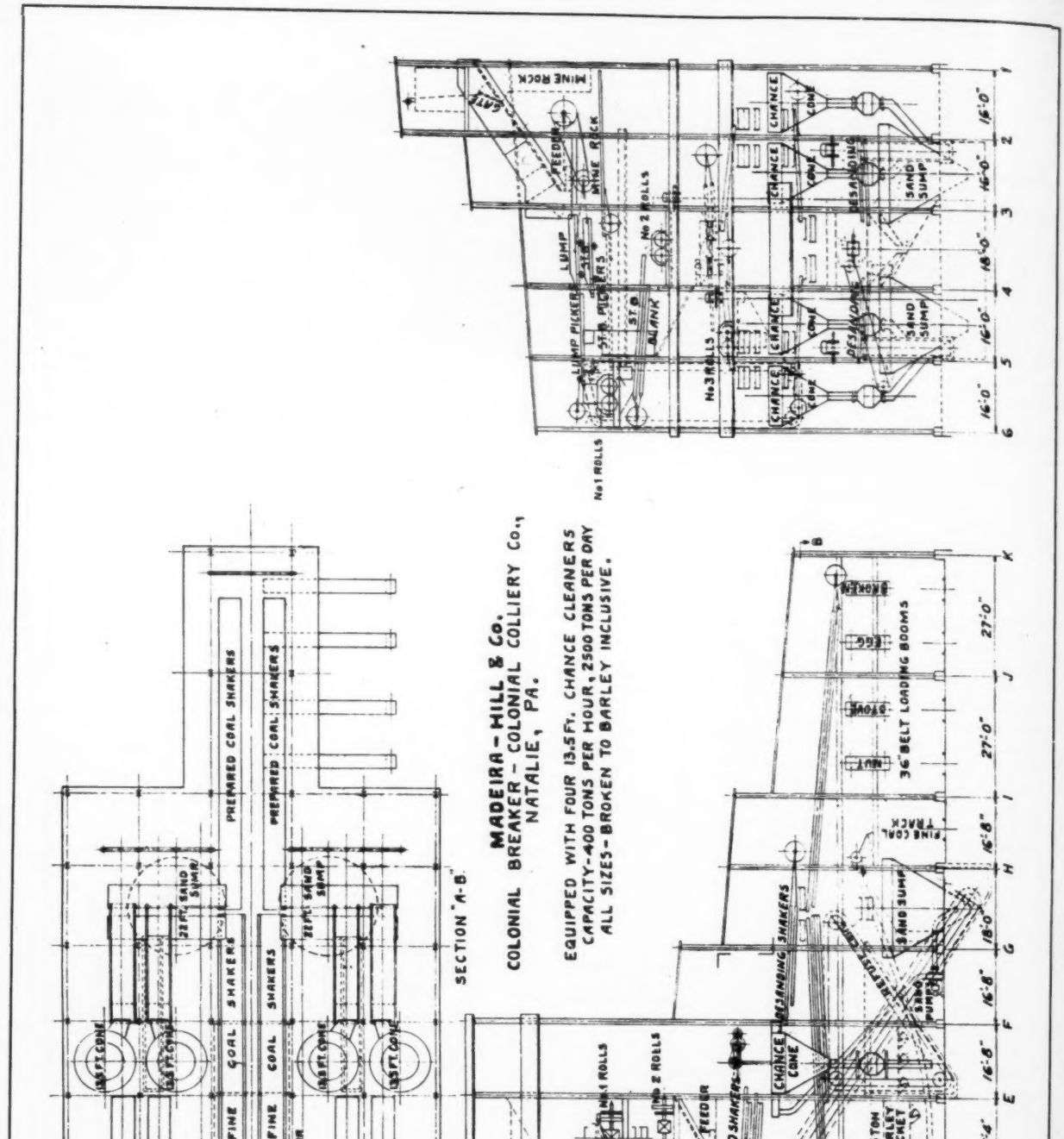



The constantly rising cost of the product in cars at the mines, added to high transportation charges and the increased margin of retailers who have to serve the public when they want it, and not when the retailer is ready to deliver it, makes the consumers' cost so high that any reduction in refuse that can be brought about by improved methods of manufacture is highly desirable.

Because of these problems, Madeira, Hill & Co. decided to abandon two old breakers, consolidating the product from these two mines into one new breaker, located midway between the two old plants, in the vicinity of Mount Carmel and Shamokin, in Northumberland County.

After a careful investigation as to the merits of the Chance Sand Flotation Process, as compared with the generally accepted method of jig preparation, they concluded that the new structure should be modern in every way, fully fireproof, and including many new features in anthracite breaker construction, such as transite asbestos siding, gypsum roofing, and Miteo steel crossbar flooring. It was imperative to make the structure completely fireproof to meet the requirements of the mine law, on account of the breaker taking its coal direct from a four-compartment hoisting shaft connected to the mines, through which the coal is hoisted and dumped into the top of the breaker with self-dumping cages, thus avoiding the de-caging of cars—a rather common use throughout the anthracite field.

The breaker embodies other extensive improvements—magnetic clutches; centralized operating control room; elimination of storage pockets for large sizes; the use of belt-loading booms to save breakage; the use of Dorr rakes and bowl classifiers for the preparation of No. 4 and No. 5 buckwheat sizes; the use of a Dorr thickener and clarifier to


MADEIRA-HILL & Co.
COLONIAL BREAKER - COLONIAL COLLIERY Co.,
NATALIE, PA.
EQUIPPED WITH FOUR 13.5Ft. CHANCE CLEANERS
CAPACITY-400 TONS PER HOUR, 2500 TONS PER DAY
ALL SIZES-BROKEN TO BARLEY INCLUSIVE.
SECTION "A-B"
MINE ROCK
GATE
FEEDER
LUMP PICKERS
No 1 ROLLS
No 2 ROLLS
No 3 ROLLS
BLANK
CHANCE CONE
DESANDING
SAND SUMP
PREPARED COAL SHAKERS
PINE COAL SHAKERS
22Ft SAND SUMP
45Ft CONE
REFUSE CONVEYOR
CRUSHER
36" BELT LOADING BOOMS
PINE COAL TRACK
FEED SHAKERS
75 TON BARLEY POCKET
75 TON RICE POCKET
75 TON BUCK POCKET
75 TON PEA POCKET

provide for a water-circulation system, so as to require the minimum amount of make-up water from the mine pumps, all of which water is neutralized with hydrated lime to save the breaker structure and equipment.

The equipment in the breaker is so designed that one-half of it can be shut down completely with a minimum loss of time in making the change.

Four 13-ft. 6-in. diameter type "F" Chance Sand Flotation Cones, together with the necessary equipment used in their operation, were installed.

The accompanying diagrammatic arrangement shows the principle of the coal cleaner. The process provides for the hand picking of sizes which pass over a 4 7/16-in. round mesh; the further screening of the sizes that pass through that mesh in order to eliminate the coal smaller than barley, i. e., the product that passes through 1/16-in. round mesh; after which the entire product (coal and refuse of all sizes, including the large coal, after crushing to commercial sizes) is sent to the cones, from which the refuse is trapped, and over which the coal flows and is then screened to the commercial sizes and loaded for market.

The separation of coal and refuse is brought about by the raising of the gravity of the water to 1.75 by the addition of sand of certain specifications, having a small percentage of particles coarser than 30 mesh, and a very small percentage of particles that will pass through 100 mesh, the object being to obtain sand fine enough to pass through a 40-mesh sieve, but not fine enough to pass through an 80-mesh sieve, and free from loam or clayey material.

The separator is conical in shape and is equipped with an agitator with projecting arms, driven with beveled gears, the function of which is to mix and diffuse through the fluid mass of sand and water the water used for agitation of the fluid mass, and in addition to break up any lodgment of sand that is likely to form in any part of the cone.

The agitation imparts a slow, revolving motion to the entire mass—sand, water and coal—and this revolving motion, in turn, transports the floating coal from the point where it is fed into the cone to the overflow through which it is discharged, the product having dropped its refuse during this operation. The bottom of the cone is equipped with a refuse chamber with two slate valves, from which chamber the slate is trapped by the alternating opening and closing of these valves. The slate that is trapped out is then conveyed from the slate sump or tank with scraper lines to a de-sanding screen, where the sand is washed out and returned to the sand sumps for reuse. The coal discharged from the cone is passed over de-sanding screens, where the coal is thoroughly washed free from sand, the sand and water returning to the conical sand sumps for reuse.

The sand sumps, as will be noted from the diagram, are located at a lower elevation than the rest of the apparatus, so that all sand and water used in the cones, and washed through the de-sanding screens after the slate and coal leave the cones, runs direct to the sumps, from which point the sand and water is pumped back with manganese lined pumps to the cones for further use.

The successful operation of such a plant depends largely upon the care exercised in designing it. This is particularly true with reference to de-sanding capacities and the extraction of the sizes smaller than barley coal from the run-of-mine product which is dumped into the cone along with the other materials. Failure to remove these fine coal particles before the product reaches the separators tends to make the sand useless. The ideal condition sought after is to put into the cones coal particles larger than the sand particles, so that after the separation of refuse and coal is made and the material is passed over de-sanding screens (coal and slate separately), during the process of de-sanding, the sand particles will pass through the screen and down to the sump, while the coal particles pass over the screen and into the various commercial sizes.

The presence of a large quantity of very fine coal, equal in size to the sand, causes a mixture of the sand and coal in the sumps, which when pumped back into the cones materially lowers the gravity, and in turn a proper separation between the coal and the refuse is not obtained.

For those who have not seen the process in operation, it is difficult to believe that the sand particles swimming from the discharge of the cone with the various sizes of coal, down to and including barley, which is made through 3/16-in. round mesh and over 3/32-in. or 1/16-in., can be thoroughly washed out of the coal.

The accompanying plan and section shows the installation of four Chance sand cones at the Colonial Colliery of Madeira, Hill & Co. The coal at this colliery is mined from 10 different veins, Lykens to Orchard, inclusive, varying in gravity, fracture and inherent ash. Notwithstanding this condition, we are able to prepare the domestic sizes of coal with frequently less than one-half of one percent of slate, and that exceedingly light, and seldom as high as 1½ percent, while the coal going to the refuse bank is frequently less than 2 percent pure coal, seldom less than 1 percent, but, of course, containing from 1 to 2 percent of coal which adheres to refuse.

The refuse banks at this colliery, including pure coal and that which adheres to refuse, seldom exceed 3½ percent coal, and is frequently less than 2½ percent, the variations depending upon the quantity of coal adhering to refuse, the care exercised in the operation of the plant and the quantity of sand used, the cost of which, including the handling, approximates 3 cents per ton of coal shipped.

Not only are the prepared or domestic sizes shipped from this breaker almost pure, so far as slate is concerned, but the small amount of slate that is present contains a high percentage of carbon, making its gravity close to that of the highest gravity coal produced.

The accompanying photograph shows the finished plant, the construction cost of which I would estimate to be approximately 70 percent of a jig-operated plant, and the operation cost of which we find to be anywhere from 10 to 20 cents per ton less than our jig-operated breakers.

This particular breaker is equipped with belt-loading booms, and the domestic sizes, chestnut and larger, are loaded directly from the sizing screens into railroad cars, with a minimum amount of drop from the end of the boom into the car, thus eliminating the use of storage pockets between the shakers and the railroad cars, which accounts for considerable breakage in the average preparation plant.

Our experience with the plant thus far shows approximately 3½ percent more prepared sizes than was gotten out of the old plants. Not all of this, however, can be credited to the use of the sand flotation process, part of it being due to the elimination of coal pockets and the use of the belt-loading booms.

The yield of commercial sizes from the run-of-mine product per mine car shows a loss of about 1/10 of a ton, which is due entirely to the radical reduction of slate shipped in the product. The gain, however, in the prepared sizes, offsets this loss, so that we find the value of the contents of the mine car to be slightly more now, as compared with the results of the old plants.

An additional proof of the wisdom in adopting the sand-cleaning process is an expanding list of well-satisfied customers for the domestic or large sizes (at premium prices), as well as for the steam or small sizes produced.

The breaker and cleaning equipment, although designed for a daily production of 2,500 tons, can readily prepare 3,500 tons.

# SAND FLOTATION AT ST. CLAIR COAL COMPANY

***Coal Treated Is Of High Specific Gravity Carrying Considerable Percentage Of Heavy Blue Coal, Which Makes Its Treatment Difficult—Saving In Labor Marked, But Offset By Unfavorable Maintenance Charges—The Management Considers Plant Successful.***

*By* H. M. SMYTH *

IN July, 1925, a new breaker was placed in operation at the anthracite mine of the St. Clair Coal Co., at St. Clair, Pa. This breaker uses the Chance process of sand flotation for cleaning the coal.

Four veins are worked at the colliery, the Mammoth, Skidmore, Seven Foot and Buck Mountain. Sixty percent of the production comes from the Buck Mountain bed, most of the balance from the Skidmore and Mammoth and a small portion from the Seven Foot. With the exception of the Mammoth bed, the coal treated is of high specific gravity, rather dull in appearance and carries a noticeable percentage of heavy blue coal or as it is termed locally "niggerhead." Successful treatment of this material is not a simple problem.

Coal from the mine is handled with a single car rotary dump, and passed over a bull shaker, a picking table to remove large rocks, thence to rolls which reduce it to broken or 3 7/16-in. round mesh. Another shaker removes it through 3 7/16-in. size, while the oversize is crushed in a second pair of rolls to egg coal and smaller.

*Breakers of the St. Clair Coal Company, St. Clair, Pa.*

The entire production is now ready for the sand flotation process and passes to the shakers which feed the cones or classifiers. These are three in number, each known as a 13½-ft. cone. Number one cone handles all sizes through ¾-inch round mesh and a portion of the over ¾-in. mesh or chestnut size. The balance of the chestnut size goes to number two cone together with all coal larger than this size.

The feed shakers are used to accomplish this division in sizes as well as to furnish the cones with a regular and even flow of coal. In addition they perform the very important function of removing the silt or culm from the feed. This consists of all material passing through a 1/16 round mesh. At times this mesh is increased to 3/32 to advantage. Careful attention to the removal of silt before entering the cones is very essential to the successful operation of the process.

In the cones the material is subjected to the flotation action of the solution of sand and water. This solution, being of a certain definite specific gravity, causes the coal to float and the rock and refuse to sink. From the cones, the coal passes over shakers which remove the sand and thence to the final sizing shakers which properly size the coal before entering the pockets ready for shipment.

The refuse drawn from the bottom of number one and number two cones is screened to remove sand and silt and then passes to number three cone. Before entering number three cone all refuse over 2½-in. round mesh is passed through crushers and ground to 1½-in. round mesh and smaller. All refuse is thus recleaned, and the coal recovered from it is passed to the pockets. The cones are so arranged that the coal recovered from the refuse can be cleaned again when necessary by returning it to either number one or number two cone. The refuse taken from number three cone is screened to remove sand and taken to the rock pockets.

Number one and number two cones are supplied with sand by two 75-h. p. Morris centrifugal sand pumps located under a conical sand sump at the bottom of the breaker. All sand recovered from the screened coal and rock is collected in this sand sump and from here the two pumps keep the solution in constant circulation.

Number three cone receives its sand from the overflow of number one and number two and does not have an independent source of supply. This feature has been found to be rather undesirable as it is not conducive to the maintenance of a sufficiently high gravity in number three cone.

Due to the heavy coal handled at St. Clair a high specific gravity must be carried in all three cones. But in order to produce the small or steam sizes of coal with comparatively low ash the gravity in number one cone is carried lower than that in number two, while number three cone, in order to float material rejected by number two and ground up, carries the highest gravity possible. In this manner specific gravities from 1.60 to 1.75 can be utilized and some experiments using crushed Birdsboro trappe rock have shown that a gravity of over 1.85 can be maintained in the cones. In this solution conglomerate rock can be floated. For almost all practical purposes, washed silica sand commonly known as "glass sand" gives good results.

The results of many inspections and tests have shown that the following results can be maintained in this breaker on the coal end:

| | Percent Slate | Percent Bone |
|---|---|---|
| Egg | 1.5 | 1 |
| Stove | 2.5 | 2 |
| Chestnut | 3.5 | 3 |
| Pea | 7.0 | .. |
| | | Percent Ash |
| Buckwheat | | 16.0 |
| Rice | | 17.0 |
| Barley | | 18.0 |

Daily tests taken at two hour intervals over a period including the months of October, November and December, 1926, show the following results on the refuse:

| | Percent Coal | Percent Bone |
|---|---|---|
| Stove | 3 | 1 |
| Chestnut | 2½ | 1 |
| Pea | 4 | .. |
| Buckwheat | 4 | .. |

The plant has a rated capacity of 1,500 tons of (*Continued on page 248*)

* Superintendent St. Clair Coal Co., St. Clair, Pa.

# THE SAND FLOTATION PROCESS FOR THE CLEANING OF ANTHRACITE AND BITUMINOUS COALS

*Used For Both Anthracite And Bituminous Coals—Enables Direct Conversion Of Steam Sizes Into Low Ash Briquettes—Increases Domestic Sizes—Produces Uniform Product Regardless Of Source—Reduces Labor, Capital And Operating Costs*

*By* T. M. CHANCE, WM. EMERY, JR., AND M. A. WALKER *

THE physical properties underlying the system of coal cleaning by the sand flotation process were first described in a paper presented at the winter meeting of the American Institute of Mining and Metallurgical Engineers in 1918. After the necessary laboratory and other preliminary experimentation, the first commercial plant was erected at the West Nanticoke breaker of the Grand Tunnel Coal Co. in the fall of 1921. This plant embodied in its original form the general proportions of apparatus that have since been used in the various plants constructed to use the process.

The commercial introduction of the system has proceeded steadily since 1921. Twenty-six plants have been laid down, of which 25 are in the anthracite region and one is used for bituminous coal washing. These plants have an aggregate cleaning capacity in excess of 10,000,000 tons per year of clean coal and are used for the preparing of all types of material, including both high-grade fresh mined coal and low-grade washery refuse. In the plants installed, all of the various sizes of coal normally shipped to market are cleaned, from broken coal to barley, some of the units being employed for all sizes, some for prepared coal only and others for the steam sizes. Among the anthracite breakers that have been designed for the use of the process, the Colonial Colliery, now in operation, and the Von Storch breaker, now under construction, are of high daily capacity, each including four Type F cleaning units with a daily rating of 3,500 tons for each breaker. The bituminous tipple of the East Broad Top Railroad and Coal Company at Mt. Union, Pennsylvania, has developed an hourly capacity in excess of 500 tons, of which about 320 tons passes to the sand flotation cleaning units.

### PRINCIPLES OF OPERATION

For many years coal cleaning performance, and the preliminary determination of the possibility of cleaning any particular coal, has been checked by the so-called float-and-sink test, in which the coal is floated from its impurities in a high density solution such as zinc chloride, carbon tetrachloride and the like. The liquids used for such testing are either of high cost or harmfully affect the washed product and they have therefore not been available for the commercial cleaning of coal by a specific gravity method of flotation.

The sand flotation process has been developed to meet the requirements of a flotational agent that would be of extremely low cost and that would not have an injurious effect upon the coal produced. The flotational agent used is a mechanical mixture of water and finely divided solids which we term a fluid mass. It is produced by maintaining ordinary sand in suspension in water by agitation produced both hydraulically and mechanically. With the silica sand that is ordinarily employed, a maximum density of 1.75 is maintained readily and in those cases in which higher densities are desired, as in ore dressing or for the differential recovery of heavy laminated boney material, solids of higher specific gravity are used in place of the silica sand or in admixture therewith. Thus a fluid mass including finely divided trap rock has been used commercially. For bituminous coal washing densities of from 1.30 to 1.50 are usually required, permitting the use of relatively much larger quantities of agitation water than can be used in the washing of anthracite.

It will be understood that many types of apparatus may be used for carrying out the process. In general, the equipment necessary to the flow sheets which we have found most desirable consists of a separating tank adapted to contain the fluid mass; desanding screens for the removal of the sand and water adhering to the washed coal removed from the upper part of the separator and from the refuse discharged from the lower portion of the separator; a common reservoir for collecting the sand and water removed by these screens; and pumping means for returning this sand and water to the upper portion of the separator.

In practice we have found that the standard types of shaking screens generally used in the anthracite regions are well suited to the desanding operations. It also appears that for the large tonnages handled by the separating units, the simple overflow of the washed coal from the upper portion of the fluid mass is the most effective way of removing the coal from the apparatus without undue breakage and this means has been employed in all of our plants. Such a method of operation requires a continuous supply of sand and water to the upper portion of the separator to replace that which is used to carry the coal out of the discharge and also that which is mechanically carried out of the separator by the refuse. This supply is pumped from the collecting reservoir, termed the sand sump, to the cones by means of ordinary centrifugal sand pumps operating under comparatively low heads.

The separating apparatus in which the flotation process is carried out is shown in Figure 1, illustrating the 10-ft. 0-in. diameter cone of the type used for washing bituminous coal. It includes a cylindro-conical separating tank provided with an intake and discharge for the coal, and an intake for the sand pump return, in its upper portion, and fitted with a cylindrical pipe at the base of the cone. This pipe is called the classifier column and serves to remove most of the sand from the refuse on its descent to the refuse chamber below, by means of the upward velocity of the hydraulic water introduced therein for the agitation of the fluid mass contained in the separating tank. This agitation is supplemented by a slowly revolving mechanical agitator which serves to distribute the hydraulic water uniformly through the upper surface of the separating zone. It may be supplemented further by additional hydraulic water introduced through jets contained in the sides of the cone.

The refuse chamber is provided with slide valves at top and bottom, the refuse being removed from the chamber by the interlocked movement of these valves. The refuse is thus discharged either into a water-sealed refuse conveyor or directly into the air. When the latter system is used it is desirable to refill the refuse chamber with water before the uppor slide valve is reopened to avoid the forcing of large volumes of air upwardly through the fluid mass. The refuse finally passes over de-sanding screens for the removal of adhering sand.

A body of comparatively clear water is maintained above the fluid mass in the separating tank. The depth of this body of water may be controlled by varying the width of the overflow discharge which removes the coal. It is desirable to maintain a considerable depth because it plays an important dual function:

1. It reduces the immersion of the coal in the fluid mass.

* H. M. Chance & Co.

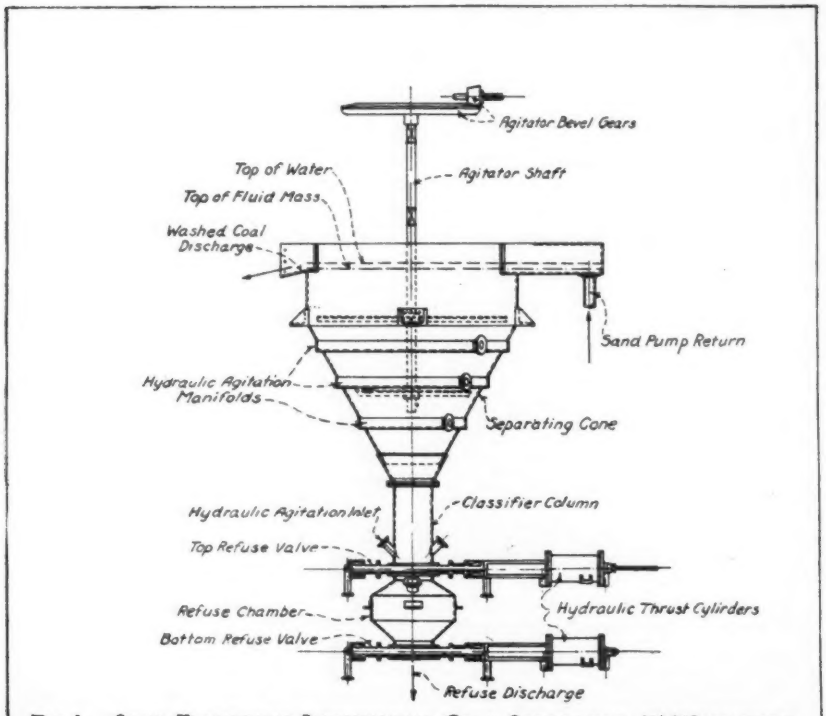



FIG. 1 - SAND FLOTATION BITUMINOUS COAL SEPARATOR - 10'-0" DIAMETER.

2. It aids in washing the sand from the coal as the latter is discharged through the falling curtain of comparatively clear water on its way to the desanding shakers.

This body of clear water is produced by the sedimentation of the sand pumped by the sand pump from the sand sump (the sand pump return slowing down to low velocity as it enters the separating tank), and also by the accumulation of the hydraulic water used for agitation, which has not sufficient velocity to lift the grains of sand in the upper part of the fluid mass and therefore flows therethrough.

The common sand sump which receives the mixture of sand and water removed by the various desanding shakers separates the clear water required for agitation, shaker sprays and the like, from the thicker mixture of sand and water returned from the lower part of the sand sump by the sand pump to the upper part of the separating cone. The clear water flowing from the sand sump carries fine coal silt in suspension and may be either pumped directly into the circulating system, as at Mt. Union, or sent to suitable thickening devices for further clarification. In multiple unit installations several separating cones may be served by a common sand sump and a common thickener.

### Anthracite Practice

The introduction of the sand flotation process in the preparation of anthracite has been accompanied by other departures in breaker practice, designed to increase the yield of prepared sizes and ultimate recovery, such as the use of loading booms, the elimination of prepared coal pockets, etc.

One of the four sand flotation breakers so far built to thus load domestic coal directly from the sizing screens into the railroad cars is the Colonial Breaker of Madeira, Hill and Company. (Figure 2.) As will be seen from the illustration, this method of loading permits the use of a much lower structure than would otherwise be possible. It is peculiarly adapted to the sand flotation process, being first introduced at the Laflin Breaker which uses this system of washing. We believe that the very noticeable gain in domestic sizes secured by the use of loading booms is not so much due to the booms themselves, as to the elimination of pocket breakage and lip-screen losses.

*Breaker Design*

The Colonial Breaker is a steel structure of thoroughly modern design, employing many features new to anthracite breaker construction such as Transite asbestos siding, gypsum roofing, etc. The breaker replaces two older plants, now abandoned, and receives its entire supply of raw coal from a four compartment shaft, the headframe of which is part of the breaker structure. Completely fireproof construction was therefore imperative and the resultant structure is a real credit to the Madeira, Hill and Company anthracite staff who evolved the entire design. It embodies other innovations, such as the underground loading of condemned coal, the extensive use of magnetic clutches, etc., all of which materially assist in economical operation.

As stated before, the Colonial Breaker is provided with four Type F sand flotation cones of 13-ft. 6-in. diameter. The breaker consists of two duplicate units, two cones, one refuse line, one sand sump and one set of feed and clean coal shakers being provided for each unit. Coal from broken to barley may be washed, the clean broken being crushed to egg when the larger size is not shipped. Lump and steamboat is hand-picked on shaking tables and both the No. 4 and No. 5 buckwheat (passing 3/32-in. round holes) is prepared, Dorr rake and bowl classifiers being provided for this purpose. The breaker water finally passes to a large steel Dorr thickener and the clarified water is returned to the breaker circulating system. Makeup water is secured from the mine pumps, being neutralized before entering the breaker.

Bony rolls are provided for crushing the larger breaker refuse, which may

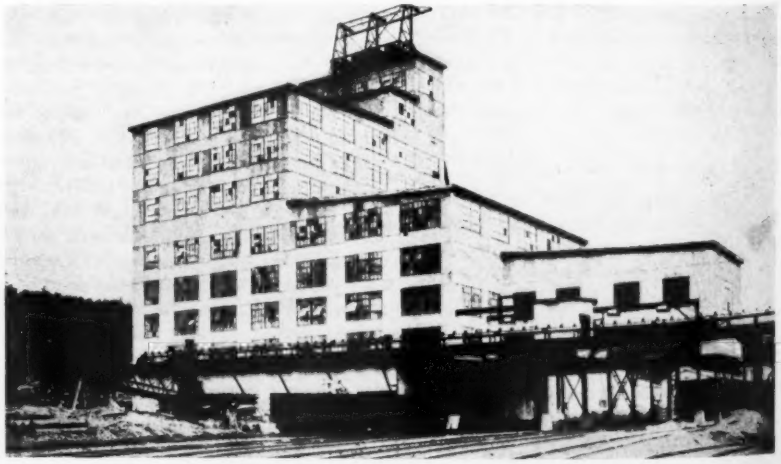


*Figure 2. Colonial Breaker, Madeira, Hill and Company*

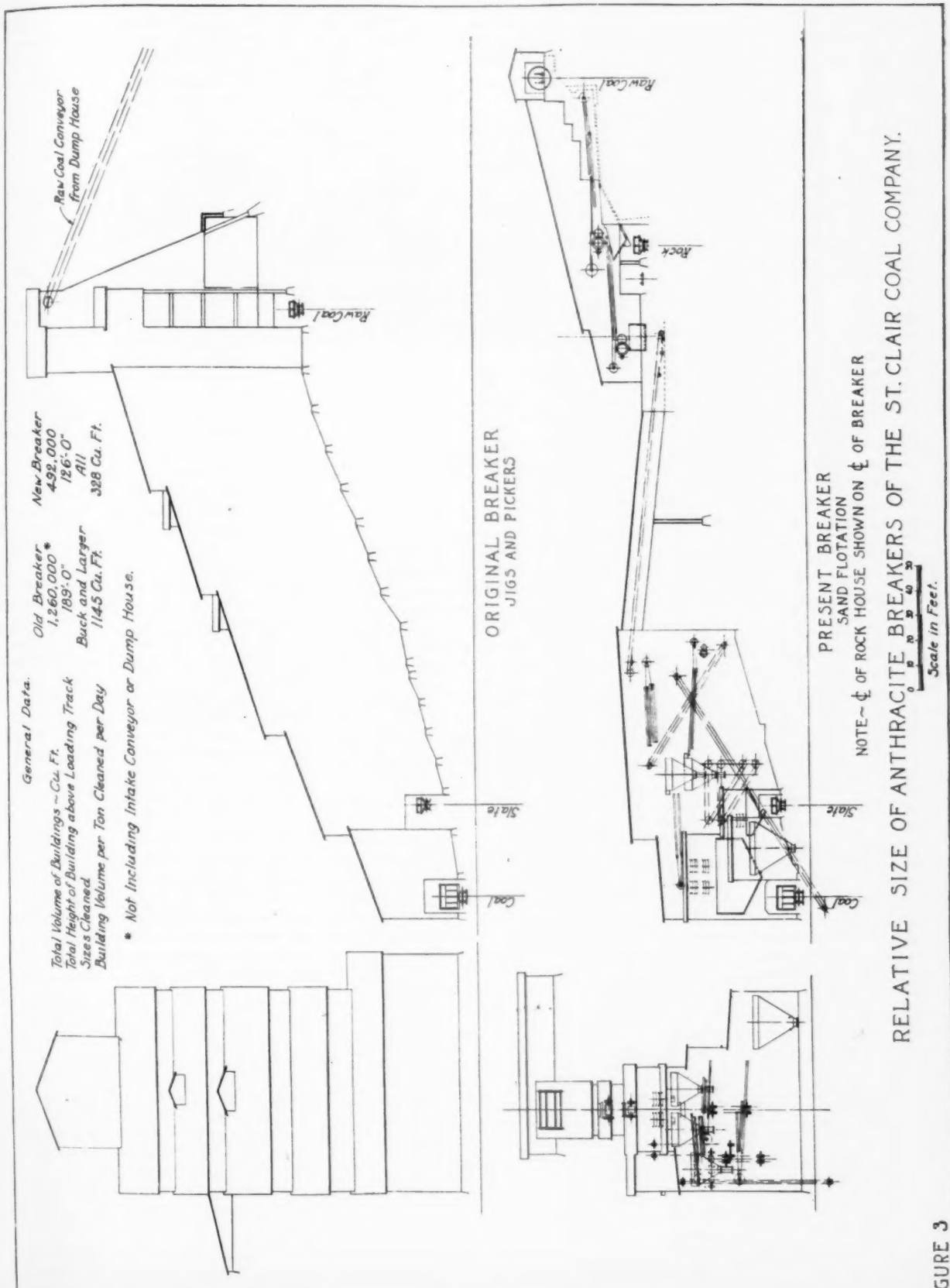



FIGURE 3

RELATIVE SIZE OF ANTHRACITE BREAKERS OF THE ST. CLAIR COAL COMPANY.

then be returned to the raw coal feed for recovery of laminated material thus set free, if such treatment should at any time prove desirable. Ordinarily, prepared coal is washed in one cone and steam sizes in the other cone of each unit, so that different densities may be employed for these two products. In addition, the feed chutes are so laid out that all sizes may be simultaneously cleaned in each cone.

A line drawing illustrating the relative proportions of the old breaker and the new sand flotation plant of the St. Clair Coal Company is shown in Figure 3. Figure 4 is a photograph of these plants taken before the razing of the old breaker. The volumes of the two structures as noted on this drawing are 1,145 cubic feet per ton of cleaned coal per day for the old plant and 328 cubic feet for the new one, the volume of the former not including that required for intake conveyor or mine car dump-house. It should further be noted that the original breaker contained no provision for cleaning the rice and barley coal, whereas the new one washes the entire product, even reclaiming much of the silt.

The general scheme at St. Clair is shown in the machinery layout illustrated in Figure 3. The flow sheet is outlined below:

*Rock House*

The raw coal, dumped from the mine cars by a rotary dump, passes directly to the bull shaker, a wide spaced grizzly being provided to check large lumps in the dump chute. This shaker removes broken and smaller and discharges lump to a shaking picking table, where large refuse is removed and delivered to the rock storage pocket. The lump coal passes to the No. 1, or crusher rolls, the crushed coal joining the broken and smaller conveyed from the bull shakers by a shaking chute. The broken coal is removed from this mixture, crushed to egg in the No. 2 rolls and mixed with the egg and smaller coal conveyed by the lower deck of the broken coal shaker. This mixture, constituting the entire breaker feed, is delivered by an apron feeder to a 36-in. belt conveyor which transports the coal to the breaker structure.

*Breaker*

The breaker feed is divided on two feed shakers into domestic coal, steam coal and silt. The domestic and steam coal pass to their respective separating cones and the silt is delivered to the silt settling tanks.

The washed coal from the two cones is delivered to a common desanding shaker, the top deck making pea and larger and the bottom deck, buckwheat and smaller, and passes therefrom to the sizing shakers. There are two sets of domestic and two sets of steam coal sizing shakers, extending across the seven loading pockets so that the length of chute is reduced to a minimum. The steam coal sizing shakers also serve to finally desand and dewater the barley coal. They are operated at 180 R. P. M. and are of 5-inch stroke, whereas all other shakers in the breaker are of 6-inch stroke and run 160 R. P. M.

The domestic coal and steam coal are loaded on a common track, the lip-screenings all passing to a chipping elevator, which also serves for condemned or foreign coal or for stocking sand in the breaker. Chutes are also provided for loading from the steam coal pockets into dump cars used to transport the steam sizes to the briquette plant stock pile.

The feed shaker silt, plus that removed from the washed coal is collected in two 15-foot underflow settling tanks, the settled silt being periodically removed by a small electrically operated clam-shell bucket. The silt is excavated alternately, the drainage secured by underflow filtration producing such dry material that is transported and stocked by ordinary dump cars, thus doing away with the usual silt pond reclamation.

The breaker as designed permits the cleaning of all of the domestic sizes in one cone and all of the steam sizes in the other cone, or of all sizes in each cone or of such division of sizes between the two cones as may appear advisable in operation. This feature provides the maximum elasticity in operating conditions and is made possible by reason of the arrangement of the feed and de-sanding shakers.

The refuse discharged from the domestic and steam cones is delivered by a common conveyor to a desanding deck of the refuse shaker and passes to the chipping conveyor. This elevates it to the rear end of the bony coal shaker where it is split into stove and smaller. The two sizes of refuse are separately crushed in two sets of bony rolls to nut and pea, remixed and elevated by the rebroken conveyor to the bony coal cone.

The coal and bone recovered by this combined crushing and washing operation is de-sanded on the bony coal shaker and returned by a second chipping conveyor to the domestic coal desanding shaker where it joins the clean coal discharged by the two primary cones. The refuse discharged from the bony coal cone is carried by a separate refuse conveyor to the refuse desanding shaker and finally delivered to the refuse pocket from which it is carried to bank by dump cars.

The bony shaker is also used for removing silt from the sand circulation, a large de-sanding area being provided for this purpose. No sand pump is required for the bony coal cone, as it is set below the primary cone de-sanding shakers and receives the sand and water recovered from the domestic coal cone, the sand and water passing the bony shaker joining the main sand return and passing to the sand sump. This common sand sump is 22 feet in diameter and is provided with two 8-in. direct-connected sand pumps serving the two primary cones. The water recovered by this sump returns to a concrete water sump, in which fine silt remaining in circulation is removed and from which the water is returned to the breaker by triplex motor driven pumps.

The three separating cones are identical, being the standard 13-ft. 6-in. diameter type F units used at a number of collieries. Group drives, provided with slip ring motors are used wherever possible and the total installed motor load of the rock house and breaker machinery is 620 H. P., including that required for the sand pumps, dump compressor and slide valve pump. The old breaker triplex circulating pumps have been retained without change.

The breaker was designed for a production in excess of 1,500 tons per day. It is, we believe, the first anthracite colliery to be especially designed for the direct conversion of all the steam sizes into briquettes of below 15 percent ash at the colliery site, the briquette plant being furnished by the Mashek Engineering Co.

The buildings are steel structures, covered with asbestos protected metal siding, and are of the type used at a number of sand flotation breakers. The entire project, including the briquette plant was erected under the direction of the St. Clair staff.

*Operating Results*

The average grade of the products produced and the cost of such production are naturally the first measures of any separating process. In this respect, the practical operation of the said flotation process has demonstrated the following advantages:

1. The production of the maximum quantity of uniformly high grade coal from either relatively pure raw coal or exceedingly impure refuse bank material.
2. Increase in percentage of domestic sizes.
3. The ability to simultaneously treat large proportions of refuse bank coal and fresh mined coal without prejudice to the salability of the product.
4. Reduction in labor, capital and operating costs.

*Item* 1

The results obtained at the Enterprise breaker of the Northumberland Mining Company are typical of the way in which Item 1 is realized. This breaker replaced

*Figure 4. Old and New Breakers, St. Clair Company, St. Clair, Pa.*

a breaker which jigged a raw coal typical of the district east of Shamokin. The products recovered are noted below:

*Clean coal*—Average of 2111 tests.

Egg to pea—33 to 55 percent less impurities than Standard Inspection.

Steam sizes—Ash content 3 to 5 percent below standard preparation in the district.

*Refuse*—Visual Inspection-Average of 608 tests.

Lare Refuse: Coal, 58 percent; Bone, 2.24 percent.

Small Refuse: Coal, 52 percent; Bone, 1.98 percent.

*Refuse*—Float-and-Sink—Average of 606 tests.

All sizes: Coal, .20 percent; Bone, 2.27 percent.

These figures show a reduction of 85 percent in the amount of salable material lost to the refuse bank over that lost from the old breaker. Performance of this kind is common at many sand flotation collieries but it is particularly interesting in this case because of the great number of tests included in the averages.

*Item* 2

A marked increase in percentage of prepared sizes is generally realized at sand flotation breakers. Thus, at one Southern district colliery, the prepared has been increased from 50 to 57 percent and at a colliery in the Wyoming field from 65 to 76.6 percent. This naturally means a large increase in average sales price for the coal and constitutes one of the primary advantages of this system of coal cleaning.

In this connection, the results at the Randolph breaker of the South Penn Collieries Company are of interest. The coal cleaned in this plant is secured from the overturned dips of Sharp Mountain, from which it was generally considered impossible to secure much over 40 percent of prepared sizes that would pass standard inspection. Further, the recovered coal generally had a "shelly" impure appearance that lowered its value. The breaker naturally was designed to secure the maximum percentage of larger sizes, being provided with loading booms, etc., and the six months' operating results given below indicate that coal from this territory can be prepared to compete financially and chemically with that from any other anthracite districts.

RANDOLPH SHIPMENTS

| | Percent Slate | Percent Bone |
|---|---|---|
| Egg | .02 | 7.43 |
| Stove | .05 | 3.28 |
| Nut | .41 | 1.35 |
| Pea | 1.97 | 3.95 |
| Average buck to barley, incl... | 16.62 percent ash | |
| Mine coal prepared..... | 54.2 percent | |

The recovery of such a high percentage of prepared sizes of negligible refuse content is in itself noteworthy, but in addition the prepared coal has none of the appearance typical of coals mined in Sharp Mountain. It appears that much of the characteristic appearance of these coals as formerly prepared was due to the presence of refuse of peculiar fracture and that when this is completely removed the shipped coal equals that of other districts in physical appearance.

*Item* 3

At sand flotation breakers admixture of bank coal with fresh mined coal does not greatly effect sale of the resultant product because both grades of coal can be prepared to the same high standard. Thus, at one colliery the percentage of such admixture has been raised from 10 percent in the old plant to 40 percent in the new. Furthermore, during last summer but two out of nine refuse bank washeries, shipping no fresh mined coal, were temporarily idle, it being possible to ship sand flotation bank coal when the greater number of the older type of bank washeries were forced to suspend because of dull markets.

*Item* 4

Labor reduction has been marked, both due to the simplicity of the process, the ability to treat large tonnages in single units, and the general compactness of new plants that have been properly coordinated. The possibilities in this direction are evident from the force of five men required for the cleaning operation at one bank washery handling up to 1,000 tons of a raw material per 8-hour day.

New Breaker construction has cost from 50 to 60 percent of that required for equivalent capacity with equally high-grade construction in breakers of the older type. This is self-evident from the ratio of 328 and 1145 cubic feet per ton of clean coal noted above in the comparison of the new and old plants at St. Clair. In addition, the much smaller structures required, reduce both insurance and upkeep costs.

Sand flotation has added the new element of sand consumption which of course is a direct charge to operating cost. The sand used per ton of coal varies widely at the different plants and is a function of the devices used in recovery and the methods employed for removing silt from the circulation. Thus, the consumption varies from less than 5 pounds per ton of coal shipped at one plant handling steam coal to 17 pounds at another colliery treating run-of-mine. At the first plant practically no silt is present while at the second very large quantities must be removed, a large portion of this removal being effected by sand sump classification.

We believe that an average of 15 pounds per ton could be taken for the various breakers as now operated, amouting to from 1.75 to 2.5 cents per ton depending on the unit cost of sand at different locations. By more thorough desilting means, this should be further reduced to an average of 10 pounds per ton, it simply being a question of balancing the sand cost per ton of coal against the desilting cost. Thus at the Mt. Union bituminous plant, where no real silt problem exists the sand consumption (with no desilting appliances) is but 2 pounds per ton of total shipments, or 3 pounds per ton of washed coal.

BITUMINOUS PRACTICE

The initial installation to use the sand flotation process was placed in operation in October, 1925, at Mt. Union, Pa. The plant was installed in the tipple of the East Broad Top Railroad and Coal Co. to clean the domestic and steam sizes of a low volatile bituminous coal mined

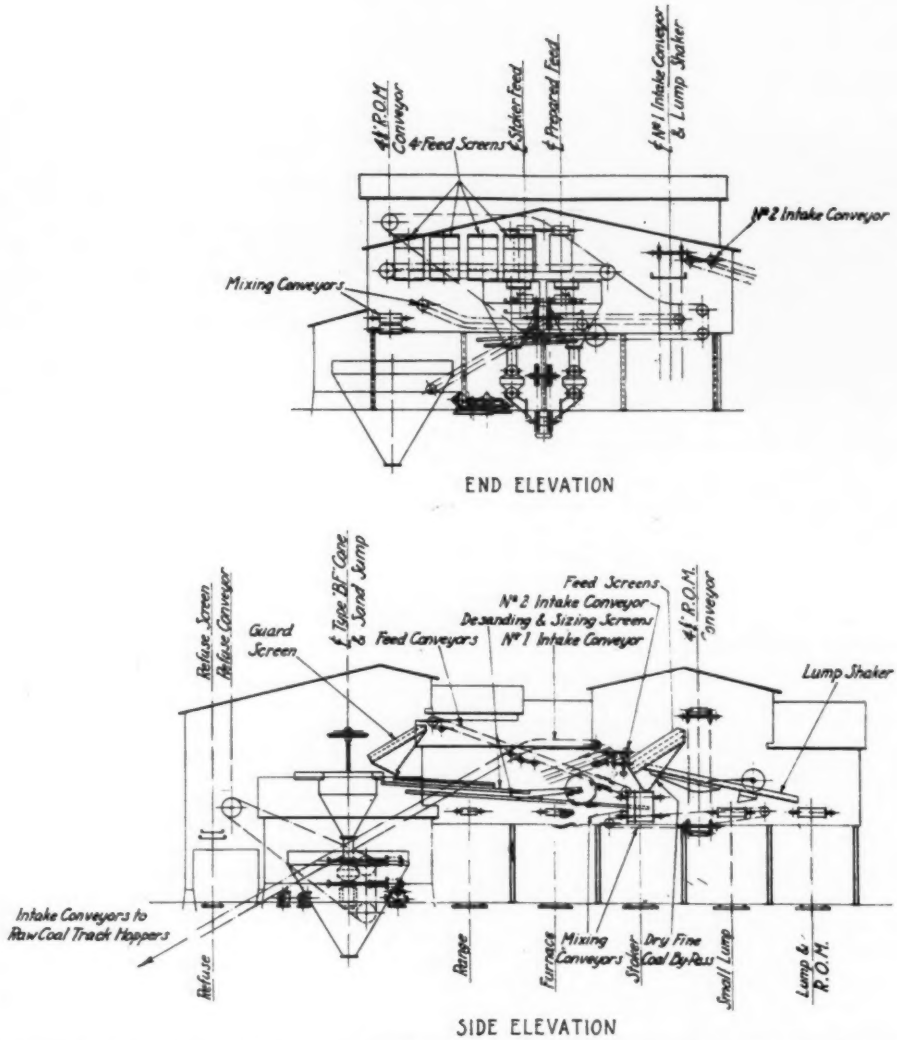



FIGURE 5.

30 miles distant and transported to the tipple in 33-ton narrow-gauge cars. The local conditions are more complicated than those usually encountered at bituminous collieries because of the variable feed due to the delivery of a large volume of coal with each train load and also due to the breakage which transfer from the large narrow-gauge cars to the standard equipment involves.

The coal possesses inherent qualities, due to its low volatile content and other physical characteristics, which permit sale in highly specialized markets. Due to the demands of such a market a five-track tipple is required and with the layout adopted it is possible to load either five sizes simultaneously, or the necessary combinations of these sizes.

The flow sheet which the present sand flotation process replaced included the picking of the lump, the furnace, and part of the range, but at least 70 percent of the output, comprising the greater part of the range and all of the stoker coal, went to market without preparation. This resulted in abnormal variations in analyses of the stoker sizes, for while the coal is inherently pure, the mining conditions in the East Broad Top field are such as to preclude continuous loading of a coal of uniform ash content, the extraneous refuse varying greatly from car to car.

However, the coal as mined follows the characteristic which we have found rather general in Eastern coals, in that the run-of-mine fine sizes are of sufficiently low ash content to permit by-passing in the raw state if the coarser coal is properly cleaned. This characteristic has permitted the production of a minus 1-in. stoker coal of sufficient uniformity in ash and sulphur for sale as a low volatile mix for by-product coke. Large quantities of this mixture of washed and raw coal have been shipped during the past year for this purpose, a market impossible to previously maintain with uncleaned coal.

*Description of Plant*

The general arrangement of machinery is shown in Figure 5 and a photograph of the plant, taken from the loaded car side, is illustrated in Figure 6. The general flow sheet is as follows:

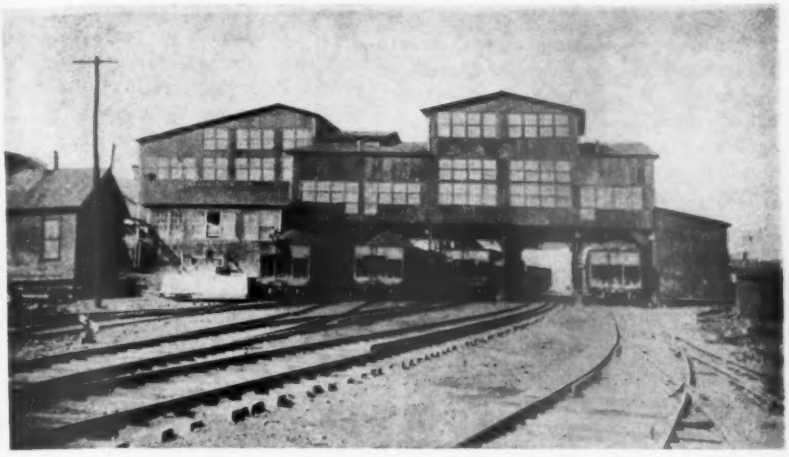


*Figure 6. Mt. Union Tipple of the East Broad Top Railroad and Coal Company*

The raw coal is fed to apron conveyors by suitable feeders from track hoppers served by the 33-ton narrow-gauge cars. The coal passes over these conveyors to a 6 ft. shaking screen which divides the feed into 4½-in. lump and minus 4½-in. resultant. The lump may be further split into 10-in. x 4½-in. lump and 10-in. lump on this shaker, both products being loaded out over picking table loading booms. The 10-in. x 4½-in. lump is rarely made, but provision is necessary for this size for certain markets.

The 4½-in. resultant is carried by a scraper conveyor to a battery of 4 Shiley double deck vibrating screens which further divide the product into domestic coal and stoker coal, at the same time removing the raw fine material. The three products produced are 4½-in. x 1-in, 1-in. x ⅜-in., and ⅜-in. x 0-in. The 4½-in. x 1-in. domestic and the 1-in. x ⅜-in. stoker are separately conveyed to two 10-ft. diameter, Type BF sand flotation cones where the final separation of the coal from its impurities occurs. One vibrating guard screen is placed between each conveyor and cone for removing degradation before entry of the coal into the cones. The minus ⅜-in. material is gathered on a mixing conveyor and is not treated.

The clean coal from both cones passes over combined desanding and sizing shakers, making 4½-in. x 2-in. furnace, 2-in. x 1-in. range and 1-in. stoker. The fine raw coal removed by the guard screen noted above is discharged to the 1-in. stoker desanding shaker.

The furnace and range coal are either loaded directly by loading booms or passed to the mixing conveyor on which both the 1-in. washed stoker, fine coal from the guard screens and minus ⅜-in. raw coal from the initial feed screens, is delivered.

The coal discharged from this mixing conveyor either is loaded directly on the stoker track as 1-in. stoker, or 4½-in. resultant, or is discharged to a crossbelt which conveys the cleaned coal to the lump track and mixes it with the lump for the production of run-of-mine. The mixing conveyor is divided into two separate sections, on one of which the stoker coal is carried and on the other the mixed furnace and range, so that it is possible to load on this crossbelt either stoker alone, mixed furnace and range alone or 4½-in. resultant, thus permitting the production of lump coal admixed with any desired smaller size.

The impurities are carried from the cones to a de-sanding screen by means of a common water sealed refuse conveyor, and are finally loaded directly into refuse cars. The cones have sufficient storage capacity to permit the shifting of the refuse cars so that no refuse storage pocket is required.

A common concrete sand sump, 21 feet 6 inches in diameter, is provided for the recovery of the sand and water reclaimed from the various de-sanding shakers, the thickened sand and water being returned to the two separating cones by a pair of 1,000 gallon centrifugal sand pumps—the circulating water overflowing the rim of this sump to a small water sump. The comparatively clean water required for agitation water and shaker sprays is returned to the washery circulation from this water sump by a 2,500-gallon centrifugal pump. The connected sand pump and circulating pump load is 100 H. P., divided equally between sand pumps and water pumps.

Makeup water is furnished by a 300-gallon centrifugal pump, this excess water being continuously run to waste as it removes from the system a certain amount of high ash, high sulphur silt. The waste water overflow is obtained from the small circulating water sump, the overflow being so arranged as to remove continuously a product of similar characteristics to that circulated by the main water pump. The makeup water supply is at times reduced to 200 gallons per minute and were there a shortage of water most of this quantity could be reclaimed by a small thickening tank.

The loss of silt is very small, due both to the fact that the dry fine coal is not wetted and also because the stoker coal de-sanding shaker is provided with 1/16-in. round hole perforations so that much of the silt in the circulating water, discharged through the shaker sprays, is recovered on the stoker coal shaker, the bed of clean coal acting as a filter.

*Labor Operating Force*

The force account at the plant is as follows:

Ground crew (8 men)—2 car droppers (raw coal), 2 car dumpers (raw coal), 1 car trimmer (lump coal and run-of-mine), 1 car patcher, 2 car droppers (cleaned coal).

Maintenance crew (5 men)—1 mechanic, 1 mechanic's helper, 1 electrician, 2 repairmen (night shift).

Loading crew (2 men)—2 boom operators.

Screening and preparation crew (6 men)—1 vibrating screen attendant, 2 lump pickers, 1 cone operator, 1 refuse valve operator and pump attendant, 1 refuse loader.

Supervision (2 men)—1 inspector, 1 foreman.

*Operating Results*

Of the total tonnage fed into the Mt. Union plant over 60 percent passes through the 4½-in. perforations on the lump shaker and is retained on the lower deck of the vibratory screens so that when shipping 500 tons per hour, the mechanically cleaned product exceeds 300 tons per hour and the product directly improved by washing, including the fine coal by-pass, exceeds 400 tons per hour. We, therefore, feel that the hourly capacity of the Mt. Union plant exceeds that of any bituminous mechanical cleaning installation so far placed in operation.

As noted before, the following sizes are shipped: 10-in. (lump); 4½-in. (lump); 10-in. x 4½-in. (lump); 4½-in. x 2-in. (furnace); 2-in. x 1-in. (range); 1-in. x 0-in. (stoker); and various combinations of these sizes. The reason for washing furnace and range in one cone and the stoker coal in the second cone is to permit the washing of these sizes at that density which will secure the desired difference in ash content required for the representative markets. It is therefore not for the purpose of facilitating the washing process, although the removal of the coarser coal before wash-

ing, rather than after, somewhat simplifies the prescreening arrangement necessary for the removal of the fine coal. However, if all the coal were used for a single purpose, such as the production of by-product coke, it would probably be desirable to clean all of the sizes in each cone, the advantage of duplicate units offsetting the screening advantage just noted.

The following analyses of simultaneous samples taken from the domestic cone unit indicate the character of the work which the plant performs:

| | % Ash | % Sulphur | B.t.u. |
|---|---|---|---|
| Raw coal (—4½ in. + 1 in.).. | 17.75 | 1.58 | 13,680 |
| Washed coal (—4½ in. + 1 in.) | 7.42 | 1.10 | 14,580 |
| Refuse (—4½ in. + 0 in.).... | 58.60 | 3.59 | 5,602 |

The raw run-of-mine coal contains but 9.5 to 10.5 percent ash, so that the coarser sizes include a concentration of high ash impurities.

Average washery coal analyses taken over a considerable period are:

| | % Ash | % Sulphur |
|---|---|---|
| Washed mixed furnace and range (—4½ in. + 1 in.)..... | 7.5 | 1.10 |
| Washed stoker (—1 in. + ⅜ in.).. | 7.1 | 1.22 |
| Raw stoker (—⅜ in. + 0 in.)..... | 7.9 | 1.10 |
| Shipped stoker (—1 in. + 0 in.)... | 7.4 | 1.20 |

It will be seen from the above table that the control of ash content made possible by the use of separate cones for the two grades of coal is realized in practice, the stoker cone operating at about 1.45 density and the domestic cone at 1.50, resulting in a stoker coal of lower average ash than the domestic coal, even though a large percentage of the stoker coal is not treated. This method of operation naturally avoids the loss of merchantable domestic bony material that would occur if this size were washed at the density necessary for the stoker coal.

These analyses indicate the advantage of by-passing the fine coal. The minus ⅜-in. coal constitutes about one-third of the total stoker, and it is evident that the average ash content of these raw fines does not increase the ash of the shipped product sufficiently to require cleaning of this fine coal. If the ash content is to be reduced, a shrinkage in weight is inevitable, whether by rejecting more coarse bone or by removing impurities from the fine coal. The washing of the fines theoretically produces a higher ash refuse, but actually the silt and other losses, and the increased equipment necessary, will generally outweight such a possible theoretical advantage. Of even greater importance is the fact that by such by-passing of the raw fine coal a satisfactory moisture content of the shipped coal is secured, whereas if the fines were washed, there would often result a product of such high moisture content as to inhibit its sale.

*Sand Consumption*

The sand consumption at the Mount Union plant has been very low, averaging for over a year less than 2 pounds per ton of total shipment, or 3 pounds per ton of washed coal. This consumption is based on the total amount of sand shipped to Mount Union and includes a large amount which was used during the year for the testing of foreign coals, when the circulating system was cleaned out to avoid contamination with the Mount Union coal. Thus the measured sand consumption of one lot of 100,000 tons shipped average about 1.4 pounds per ton of coal washed. However, for purposes of estimate we have charged the entire sand shipped into the plant against the entire tonnage shipped out without making any allowance for consumption other than that due to normal operation, thus arriving at the figure of 2 pounds of sand per ton shipped. We believe that the small sand consumption is largely due to the low density mixtures circulated and to the high cleaning capacity of comparatively small units. The sand is of the same specification as that used at anthracite plants.

*Sludge Loss*

Tests made over a long operating period indicate that the fine material lost from the system averages around 0.3 percent, of from 15 to 16 percent ash and from 2.0 to 3.8 percent sulphur. It is, therefore, not a highly desirable material to reclaim, and even if of lower ash and sulphur content would be of such high moisture as to make it of doubtful value. The negligible tonnage of sludge produced is self-evident from the fact that the plant has functioned for over a year with no settling or thickening devices for removal of sludge from the circulating water.

*Uniformity of Feed*

The large feed pockets that are generally deemed essential for smoothing out variation in rate or quality of the feed have not been required at Mount Union, and this is a characteristic feature of the sand flotation process. While it is, of course, possible to so overcrowd the cones as to impair efficient operation, ordinary changes in the rate of feed or its complete cessation, and marked changes in the quality of the coal passing to the plant from time to time, have little or no effect on the efficiency of operation and no adjustments are made to accommodate the plant to them. The feed, therefore, stops and starts as the cars are dumped, irrespective of the operation of the cones, a feature of especial value in bituminous washing, as car changing and other interruptions occur without disturbing the operating results.

In the washing of coals containing great variations in the percentage of fine coal impurities, storage of the fine coal by-pass from the vibrating screens might be of advantage, because this fine coal could be passed through mixing hoppers without consideration of the breakage involved and the resultant mixture of fine coal fed at a constant rate into the washed coal stream. This would obviate peaks in the ash curve due to momentary increase in fine coal impurities, the fine coal being fed as a mixture of fairly uniform grade and the washed coal being, of course, cleaned to a uniform standard. We would thus have many of the advantages of a feed of constant character without the breakage and other disadvantages incident to the storage of the lump and domestic sizes of raw coal.

*Moisture*

Tests made over an eight-month period have demonstrated an average added moisture content of less than 0.5 percent. Average car samples range from 3.5 to 5.0 percent moisture in the 1-in. stoker size, dependent upon the condition of the coal after the long haul from the mines. We do not think that low-moisture coal of this character has been produced hitherto by wet-washing plants. The results obtained are secured without any extraneous draining or settling devices, the only drainage screens being the segments provided on the sizing coal shakers. The low-moisture content is due to:

(a) So cleaning the coarse coal that the fine coal need not be washed.

(b) Reduction of breakage and internal sludge production.

*Construction Costs*

The cost of the washery addition, including the cleaning and screening arrangements, together with the necessary steel frame buildings, was less than $50,000. From the figures available of the total cost of alterations and additions in the old tipple, we believe that a complete replacement tipple, if designed as an entirely new unit of 500 tons hourly capacity, could be built for $125,000 to $150,000. These costs would include the complete plant, including intake lines, rotary dump and necessary lump coal loading and handling facilities. In general, the complete washing and screening section, together with the necessary building, etc., required, will cost about $250 per ton of hourly capacity, although these figures naturally will vary with the local conditions of installation.

*General Operating Data*

A general summary of the operating results of the eight-month period from January 1 to (*Continued on page* 245)

# METALS

## PRACTICAL OPERATING MEN'S DEPARTMENT

GUY N. BJORGE, Editor

*Practical Operating Problems of the Metal Mining Industry*

# NEW FEATURES IN CONCENTRATING MESABA RANGE ORE

*Much Interest Has Followed Developments In The Concentration Of A Hitherto Unbeneficiated Class Of Material On The Mesaba Range By The Mary Ellen Mine Of Butler Brothers—A Description Of The Mill And The Problems Encountered And Solved*

*By* A. K. KNICKERBOCKER*

THE Lake Superior iron ore industry is in such a highly developed state that it can readily supply in excess of 85,000,000 tons per year against a present annual demand of 50,000,000 to 60,000,00 tons. This overdevelopment has caused an unhealthy condition in the industry. This condition will continue for some time, but there are indications that the capacity curve is at or near its peak. The iron ore reserves of the region, while large, are known and limited, and in view of the heavy annual demands put upon them their life can be forecasted with some accuracy.

It is generally agreed that within 15 to 20 years we will begin to see a scarcity of direct shipping high-grade ores. In fact, the scarcity would become noticeable much sooner were it not for the important tonnages of beneficiated ores which reach the market in increasing amounts each year. Probably 40 percent of the annual tonnages shipped from the Mesaba Range is now the product of beneficiation in some form or other.

Huge aggregations of capital have made tremendous investments in plants, docks, ships, railroads, and mines, and a great many of these investments are founded and base their existence on the use of Lake Superior iron ore. Fifteen or twenty years is a short period in the life of such aggregations of capital. The profound economic and social changes which may ensue to the country with diminution of the yearly supply of Lake Superior iron ore would be vast, far-reaching, and hard to visualize. They would affect, directly or indirectly, nearly every worker and investor in the country.

To the postponement of the day of exhaustion of these important reserves of iron ore, we must look to beneficiation. For this reason the operation of the Mary Ellen Mine in treating a hitherto unbeneficiated class of material on the Mesaba Range has been watched with some interest.

The Mary Ellen Mine is located near Biwabik, Minn., near the eastern end of the Mesaba Range. The mine is a steam shovel pit. Stripping was started in the fall of 1923; the mill was constructed that winter and put in operation in June, 1924.

The material treated is a more or less decomposed and banded ferruginous chert, or taconite, as locally called. The bands of ore vary in thickness. They are generally high-grade, hard, blue or red hematite, but some silicious, partly porous bands are present. The chert is everywhere iron bearing, and is in all stages of decomposition, due to the action of circulating water. Degree of decomposition varies from one extreme to the other in extremely short distances, both laterally and vertically. Some layers, or parts of layers, present their original hard, cherty structure, having been scarcely touched by weathering influences. Others have been decomposed almost to the condition of a true wash ore or a mixture of finely divided sand and ore, and the rock is present in all stages of decomposition between the two extremes mentioned.

The crude material averages about 40.75 percent dried iron, 35.50 percent silica. Ordinary processes of washing result in a betterment of this material to about 51.50 percent dried iron, 18.50 percent silica. This material being unmerchantable, some other means of beneficiation was necessary, and, after some testing, treatment by means of jigs was indicated. Beneficiation by jigs resulted in a product averaging, for a year's shipment, 58.22 percent dried iron, 9.90 percent silica, and less than 4 percent moisture. The product has an excellent, physical structure, less than 1 percent passing a 100-mesh sieve, and all being crushed below 1 inch. It handles easily everywhere, and is a desirable furnace material from every standpoint.

The process used is not a complicated one. The crude material is grizzlied and screened and crushed in its dry condition to pass a 1-inch screen. The minus 60-mesh material, averaging 22 to 25 percent of the weight, and which is a sand carrying usually 10 percent of iron or less, is next removed by ordinary wash-

* Manganiferous Iron Co., Stanley Mining Co., Crosby, Minn.

ing. The remaining material, a mixture of crushed rock and ore, is then separated into six sizes by means of suitable screens. Material of each size is then jigged separately, except the smallest size, which is minus ⅛-inch and which is not treated on jigs, but is handled in a manner to be mentioned later.

The six sizes made in 1926 were as follows: Minus ⅛-inch; ⅛ to ¼-inch; ¼ to ⅜-inch; ⅜ to ½-inch; ½ to ¾-inch; ¾ to 1-inch. Prior to 1926, crushing was done to 1½-inch and two additional sizes were made, 1 to 1¼-inch, and 1¼ to 1½-inch. As a general proposition, it may be stated that the crushing of Mesaba Range ores for subsequent treatment on jigs should be done with the idea in mind of having in the crushed product, first, the smallest possible percentage of oversize above a certain predetermined limit; and, second, as small a percentage of fines as possible. The certain predetermined limit mentioned is that point at which values fail to be economically freed, and the material should, in general, be crushed just as coarse as possible, with the minimum percentage of fines, and still permit of proper freeing of ore and rock. The smaller the size of iron ore jigged, the smaller the metallurgical efficiency of jigging will be. At the Mary Ellen, the sizes which jig at the greatest efficiency are the two between ½-inch and 1-inch. Crushing to 1½-inch also failed to thoroughly free the values, and there is no question that 1½-inch iron ore is extremely large and heavy stuff to jig. The aim now is to crush so that no piece will be larger than 1-inch and at the same time make the least possible percentage of fines.

The rated capacity of the mill is 2,000 tons of crude ore per day. Crushing will be done in 1927 by means of a primary jaw crusher, 28 by 44 inches, set at 5 inches, and four 8 by 36-inch secondary jaw crushers set to crush to finished size. Other methods of crushing have been used, but results were not satisfactory. Scalping ahead of the primary crusher is done by evenly feeding the crude material over a stationary inclined bar grizzly. Screening between the primary and secondary crushers is done in a 60-inch by 12-foot trommel, covered with 1-inch square mesh cloth.

After crushing, the material is conveyed to the mill and washed and sized. Leahy vibrating screens do most of the sizing. A Dorr duplex rake classifier (8 ft. by 26 ft. 8 in.), overflowing at 60 mesh, is used for washing. Seven jigs are used. They are the McLanahan improved ore jig, made by the McLanahan-Stone Machine Co. These jigs were developed and perfected for use on iron and manganese ores after many years of trial and experimentation, and have been successful in jigging iron ores wherever used throughout the country. They are well and strongly constructed, simple and inexpensive to operate, have large capacity, and successfully make iron ore concentrates on all grades of material and all rates of feed. They use scarcely any water, 5 to 10 gallons per minute sufficing per jig. It is a non-suction jig, the suction effect of the up-stroke of the plunger being minimized by the ingress of water into the plunger compartment through openings controlled by an ample number of rubber valves. The non-suction principle is a vital one in separating two such materials as iron ore and iron-bearing chert, where the difference in specific gravity is not great.

The Mary Ellen Mill has proven nothing except that Mary Ellen ore can be jigged. Undoubtedly there are similar deposits of banded chert and hematite elsewhere, and in time, as need for ore arises, it is reasonable to suppose efforts will be made to develop them. All such efforts should be preceded by thorough testing. The testing should cover all parts of the ore body, for these chert and ore formations vary greatly from place to place even in the same ore body. Sufficient testing having been done to demonstrate jigging capabilities of the material, it may safely be said that the jigging itself will offer no particular difficulties.

Some mention has been made of the crushing problem. This is the most expensive part of the operation, and is a vital one, since the crude material must be gotten in the proper physical condition for the most efficient jigging and at the same time be gotten into the mill in quantity, if concentrates in quantity are to be gotten out. This problem is not incapable of solution, and a good part of the expense involved is offset, especially to those operators using their own ores or selling to affiliated furnace interests, by decreased costs in cars, docks, boats, and furnaces, due to the very desirable physical structure of the product.

The handling of the smallest size, minus ⅛-inch, is still somewhat of a problem. Experiments with tables have been unsatisfactory. High-grade concentrates can be made by jigs, but metallurgical losses are heavy and jig outputs low. It would seem a jig could be developed for this fine material which would operate at good efficiency and fair output and have some sort of automatic control which would obviate the necessity of close and constant attendance, which now seems necessary for the successful operation of a jig on this material. The Mary Ellen Mill for the past two seasons has been hydraulically classifying this material by means of Deister cone classifiers, together with screens, Dorr rake classifiers, etc. Fairly satisfactory results have been attained, but the results are still far from ideal, and the handling of this material may still be said to be in the experimental stage. The ideal machine for the separation of this material, automatically, continuously, without close attendance, and under varying conditions of grade and feed, is still to be developed. This is a detail that can not fail in time to be solved.

## BENEFICIATING IRON ORES OF LAKE SUPERIOR

THE tendency in recent years in the Lake Superior iron ore district has been toward increased beneficiation of the ores. This applies particularly to washing, crushing and screening, and numerous washing plants have gone into operation, while large crushing and screening installations have recently been completed.

The accompanying table shows the tonnages of iron ore that have been beneficiated during the last three years in the Lake Superior district. In 1925, 28.6 percent of the total shipments were beneficiated, the percentage increasing to 35.9 percent in 1926. Shipments from the Mayville-Baraboo ranges are included in the total.

The drying of ores has shown some falling off in the last three years, with only 157,336 tons so treated in 1926 as compared with 409,026 tons in 1924.

The washing of iron ores to remove the silica is done largely on the western Mesaba from Coleraine to Nashwauk, with other plants at other districts on the Mesaba. All of the washing and jigging of ores in 1926 was done in the Minnesota mines, with no plants in operation in Michigan and Wisconsin. Of the ores treated by sintering, nodulizing and briquetting in 1926, there were 12,115 tons shipped from Minnesota and 125,946 tons from Michigan and Wisconsin mines. Only 146 tons of Michigan and Wisconsin ores were dried last year, the balance being from Minnesota. Of the ores crushed and screened in 1926, 9,533,775 tons came from Minnesota and 6,297,898 from Michigan and Wisconsin. Total tonnages of ore beneficiated of the 1926 shipments amounted to 15,101,077 tons from Minnesota mines and 6,423,990 tons from Michigan and Wisconsin mines.

**Tonnage of Beneficiated Iron Ore Included in Shipments from Mines—Lake Superior District**

| | 1924 | 1925 | 1926 |
|---|---|---|---|
| Washing | 4,728,504 | 6,177,417 | 5,297,498 |
| Jigging | 40,037 | 113,638 | 100,499 |
| Sintering, nodulizing and briquetting | 51,703 | 123,209 | 138,061 |
| Drying | 409,026 | 258,680 | 157,336 |
| Total | 5,229,270 | 6,672,944 | 5,693,394 |
| Crushing and screening | No record | 9,244,087 | 15,831,673 |
| Grand total | | 15,917,031 | 21,525,067 |
| Total shipments | 43,896,361 | 55,534,812 | 59,970,009 |
| Percentage Beneficiated | | 28.6% | 35.9% |

*(From Skilling's Mining Review.)*

# VENTILATION PROBLEMS AT THE UNITED VERDE MINE*

***With Continued Vertical Depth The System Formerly Used Proved Inadequate, And The Company Has Since 1924 Expended $150,000 Improving Old And Establishing New Airways—A Comprehensive Description Of Conditions And How They Have Been Met***

By C. E. MILLS†

THE ore bodies at the United Verde are of the schist replacement type, the main sulphide mass consisting of a huge pipe-like body, approximately seven acres in cross-sectional area and extending from the surface to the lowest levels and dipping steeply to the northwest.

The commercial ore bodies occur along or near the southeasterly contact of the pyrite mass. On the upper levels the ore zone is approximately 600 feet by 1,100 feet and lenticular in shape, whereas on the lower levels the mineralization is confined more closely to the iron-schist contact and the ore bodies extend about 1,000 feet along the contact and will vary from a few feet to 250 feet in width.

The upper portion of the mine has been on fire since 1894 and is now being mined by shovel and open-cut methods. Underground mining operations at the United Verde extend from the 400-level, at an elevation of 5,114 feet, to the 3,000-level, at an elevation of 2,528 feet. There are approximately 50 active stopes above the 2,400-level, and approximately 55 development faces. The 50 stopes are located on 14 levels, so it is evident that no levels are completely mined out and all require ventilation.

The average monthly tonnage from underground operations for the first 11 months in 1926 was 66,646 dry tons. The shovel pit supplied 40,815 tons per month, making a total monthly production of 107,461 tons.

Of the underground tonnage, the following percentages were mined by various stoping methods:

| | Percent |
|---|---|
| Cut and fill | 57.2 |
| Square set | 16.3 |
| Top slice | 12.3 |
| Shrinkage | 6.1 |
| Underhand | 8.1 |
| Total | 100.0 |

## GENERAL SYSTEM OF VENTILATION

The primary ventilating system for the underground mine is provided for by a No. 15, two-thirds width, Sirocco fan located on the 1,000-level. This fan delivers approximately 200,000 cu. ft. of free air per minute, the air to the fan being pulled through Hopewell Tunnel and No. 5 Shaft. Figure 1 is a plan of the 1,000-level showing the fan location with respect to the intake and outlet airways.

The need of a new inlet to the fan and the necessity of a new fan installation will be discussed in detail later. The air from the delivery side of the fan passes through an 8 ft. by 18 ft. inclined raise to old No. 3 shaft (refer to

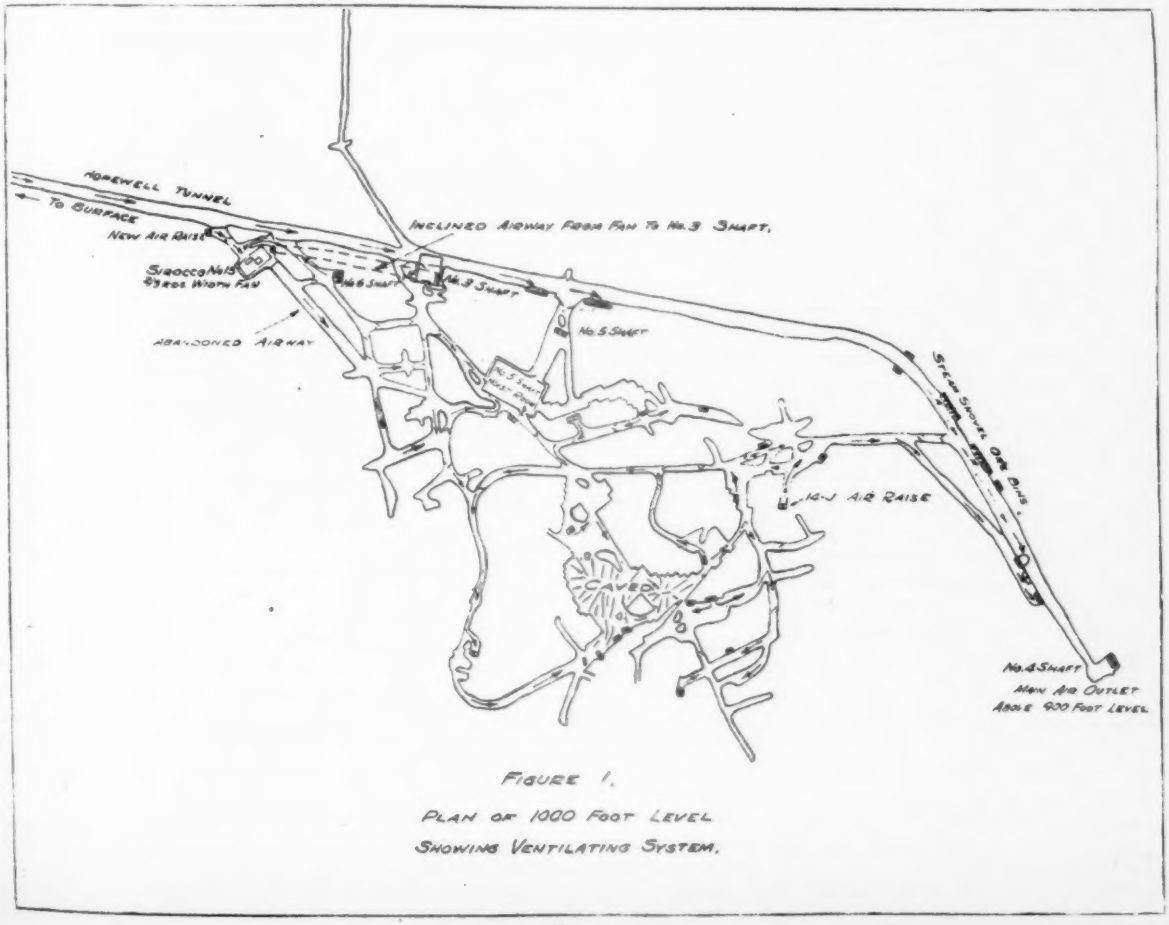



FIGURE 1.
PLAN OF 1000 FOOT LEVEL
SHOWING VENTILATING SYSTEM.

*Figure 1*

* Paper presented to annual meeting Arizona Chapter, The American Mining Congress.

† Chief Engineer, United Verde Copper Co.

Figure 2). This shaft has been stripped of timbers and is used exclusively as an airway. It is 7 ft. by 17 ft. in cross section and extends vertically to the 1,950-level. From here to the 2,400-level, the raise has been inclined toward the ore body. This raise has been concreted at each level station and provided with adjustable steel doors to allow a definite volume of air to be taken off on each level. The volume delivered to each level may be changed from time to time to suit the working conditions of the stopes and the number of men working on the various levels.

The approximate volumes of air delivered to each level, with the corresponding temperatures, are tabulated below:

| Level | Volume Cu. Ft. | Wet Bulb Temperature | Dry Bulb Temperature | Relative Humidity |
|---|---|---|---|---|
| 1,200..... | 10,000 | 59 | 67 | 62 |
| 1,350..... | 15,000 | 62 | 67½ | 72 |
| 1,500..... | 18,000 | 62 | 68 | 71 |
| 1,650..... | 25,000 | 62 | 68½ | 69 |
| 1,800..... | 23,000 | 62½ | 69 | 70 |
| 1,950..... | 19,000 | 62½ | 70 | 66 |
| 2,100..... | 24,000 | 63 | 70½ | 67 |
| 2,250..... | 14,000 | 63½ | 69½ | 72 |
| 2,400..... | 27,000 | 64 | 69 | 76 |
| Total.... | 175,000 | | | |

Note.—This data was taken in April, 1926.

The air taken off on each level from the main air raise is delivered through the main drifts at a velocity of approximately 300 feet per minute to the ore body, and thence up chutes and manways to the working stopes. From the stopes the air goes to the level above through waste raises or manways, and thence on up through the various workings to the 1,500-level, where the greater portion of the vitiated air is collected and sent up through the 13-M airway to the 1,000-level.

From the 1,000-level, the stale air is delivered to the 900-level through two abandoned ore bin raises. From the 900-level, it is delivered to the surface through No. 4 shaft, which is now being stripped and concreted. The main ore raises from the shovel pit leading down to the 1,000-level also act as outlets for the vitiated air.

The levels between the 1,000-level and the 400-level are ventilated in part by air which comes up from the workings below and in part by fresh air from the lower levels delivered through No. 5 ore shaft, which extends up to the 800-level.

A No. 8, double inlet, Sirocco fan on the 300-level delivers 20,000 cu. ft. per minute and serves to lower the extreme temperatures of the workings in the fire country vicinity.

Figure 2, showing a vertical section through the mine, gives a general idea of the ventilating system now in use.

### Temperature and Humidity

The standard aimed at in providing air to the various working places is to keep the temperature between 75° and 80° F., relative humidity not over 80 percent, velocity 125 to 150 feet per minute, and a volume of 250 to 350 cu. ft. per minute per man.

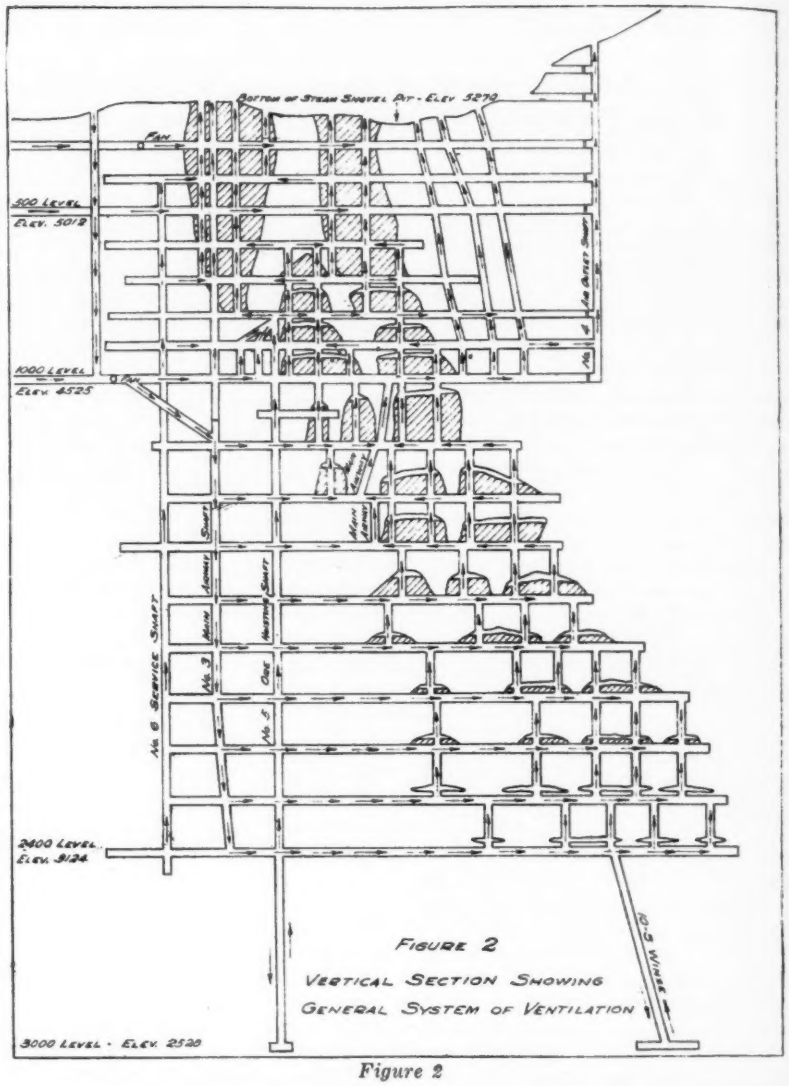



*Figure 2*

The wet and dry bulb readings are not always a true index to the working conditions of a stope or face. For still or stagnant air, the maximum wet bulb temperatures may be 75° F.; where the air movement is appreciable, the wet bulb reading may be as high as 85° F. and the working conditions may still be rated as comfortable. Although it is desirable to keep the relative humidity around 80 percent, yet a relative humidity of 90, or even 95 percent, is often permissible if the temperature is under 80° F., or the air in constant motion.

The Kata thermometer is preferable to the hygrometer in determining the working conditions of a stope or face, but the instrument is more delicate than the hygrometer and is not used at this mine. The Kata readings corresponding to a 78° F. temperature, 80 percent relative humidity, and a velocity of 125 feet per minute, are 5.7 dry and 14.8 wet Kata.

The following tabulation of average temperatures and relative humidities in working stopes on the various lower levels shows the effect of passing air up through from one level to another:

| Level | Wet Bulb | Dry Bulb | Relative Humidity |
|---|---|---|---|
| 2,400 ..... | 73 | 77 | 82.4 |
| 2,250 ..... | 73.5 | 77 | 84.6 |
| 2,100 ..... | 73.5 | 76.5 | 84.6 |
| 1,950 ..... | 75 | 76.5 | 93.1 |
| 1,800 ..... | 74.5 | 76 | 93.1 |

This practice not only increases the relative humidity, but the air becomes more vitiated as it travels upward. It also requires careful timing of blasting periods to prevent $SO_2$ gas and powder smoke from reaching workers on levels above before they are able to blast their rounds and reach the shaft station.

A separate raise system for handling the vitiated air from each level is needed

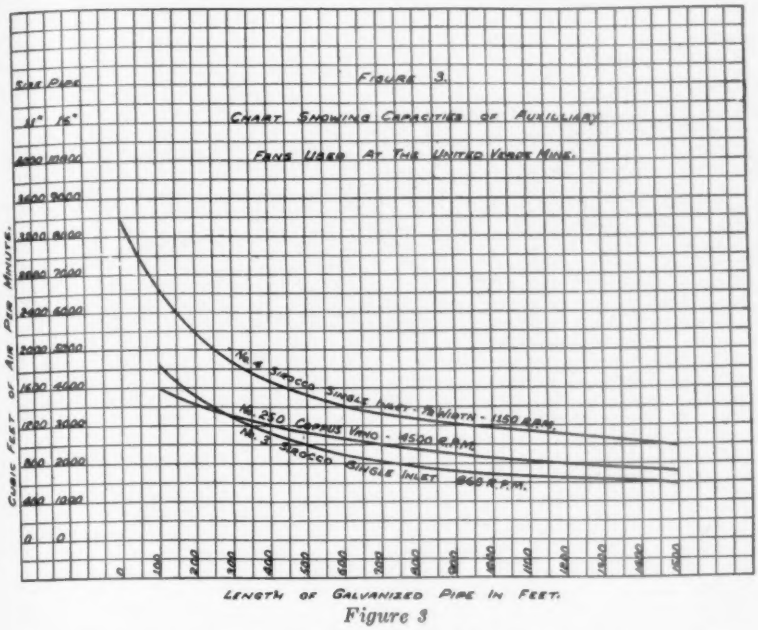


FIGURE 3.
CHART SHOWING CAPACITIES OF AUXILLIARY
FANS USED AT THE UNITED VERDE MINE.
SIZE PIPE
12" 15"
CUBIC FEET OF AIR PER MINUTE.
No. 4 SIROCCO SINGLE INLET - 76 WIDTH - 1150 R.P.M.
No. 250 CAPPUS VANO - 4500 R.P.M.
No. 3 SIROCCO SINGLE INLET 860 R.P.M.
LENGTH OF GALVANIZED PIPE IN FEET.

*Figure 3*

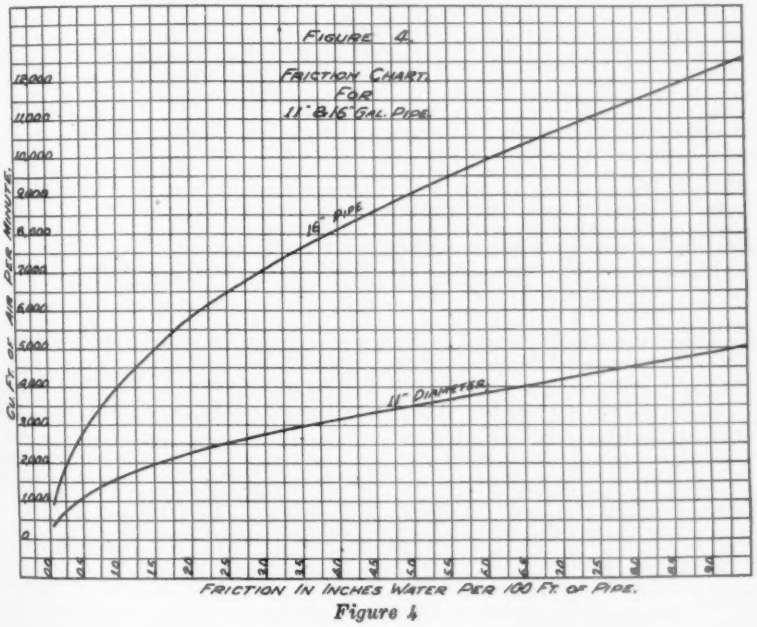



*Figure 4*

very badly. This will allow the various levels to be grouped into splits and the stale air from each split will be delivered directly to the outlet raise instead of being passed up through the working places above. A tentative plan has been worked out and a system of splits will be installed in the near future.

### Gases

In any ventilating system it is essential to supply sufficient air at sufficient velocity to carry away gases and dust caused by blasting. At this mine the afternoon shift is lowered fifteen minutes after the day shift is hoisted, so that it is essential that all headings and stopes be well ventilated.

The massive sulphides at the United Verde contain as high as 46 percent sulphur and blasting in "hard iron" forms sulphur dioxide ($SO_2$) and hydrogen sulphide ($H_2S$) gas. Sulphur dioxide gas is very irritating to the eyes and respiratory passages and a concentration of 0.05 percent is dangerous upon exposures longer than thirty minutes in duration. Hydrogen sulphide gas is very dangerous and is comparable to hydrocyanic acid gas in toxicity. It is formed by the reaction of water vapor and sulphide dust, and a concentration of 0.06 percent or greater will cause unconsciousness within two minutes and death in two to fifteen minutes. Gases from blasting in heavy sulphides were analyzed by the Bureau of Mines * and samples, taken fifteen minutes after blasting in a drift, showed 0.09 percent $SO_2$ and 0.07 percent $H_2S$.

In addition to the danger of toxic gases from blasting in heavy sulphides, there is also the danger of dust explosions, particularly in dry stopes where sulphide dust has collected on the walls. Experimental work is now being conducted by the Bureau of Mines and the powder companies and the development of a short flame explosive will reduce the danger from secondary dust explosions in heavy sulphide stopes.

### Dust

All machines used in the underground mine are wet and very little dust is caused from drilling. Sulphide dust, caused by passing shovel ore down through the ore raises and by loading from the main ore bins on the 1,000-level, has proven troublesome at times, but a system of airways is now being installed at these main ore raises and conditions will be alleviated to a large extent in the near future.

The most serious trouble caused by dust is on the upper levels below the shovel workings. The massive sulphides have been on fire since 1894, and, although bulkheaded off from the rest of the workings, the temperature of the workings outside the fire zone is very high and there is constant danger from fire. The timbered sections have been gunited as a protection against fire.

In one instance a churn drill hole had been drilled close to No. 7 main ore raise and in rock with a temperature of 300° to 400° F. This raise was open down to the 900-level, but was sealed off from the main workings by heavy bulkheads. Upon blasting, several hundred tons of finely divided sulphides was sent down the raise, presumably causing a dust explosion which blew out the bulkheads. Dust and $SO_2$ gas was forced into some of the main workings, resulting in three fatalities.

Out of 121 serious accidents during the past year, six were gas cases. Out of eight fatalities, five were caused by $SO_2$ gas and dust from the fire country. But fourteen minor gas cases were caused from powder smoke or poor air, the greater portion of these being one day cases.

### Secondary or Auxiliary Ventilation

In dead ends of drifts, raises, or stopes, where it is impossible to supply sufficient air from the primary ventilation system, auxiliary or secondary ventilation must be resorted to. Two types of blowers are used at this mine—a No. 3 Sirocco, direct connected to a five h. p., d. c., 860 r. p. m. motor, and a

* Bureau of Mines publication, serial 2739, dated March, 1926, by E. D. Gardner, G. W. Jones, and J. D. Sullivan.

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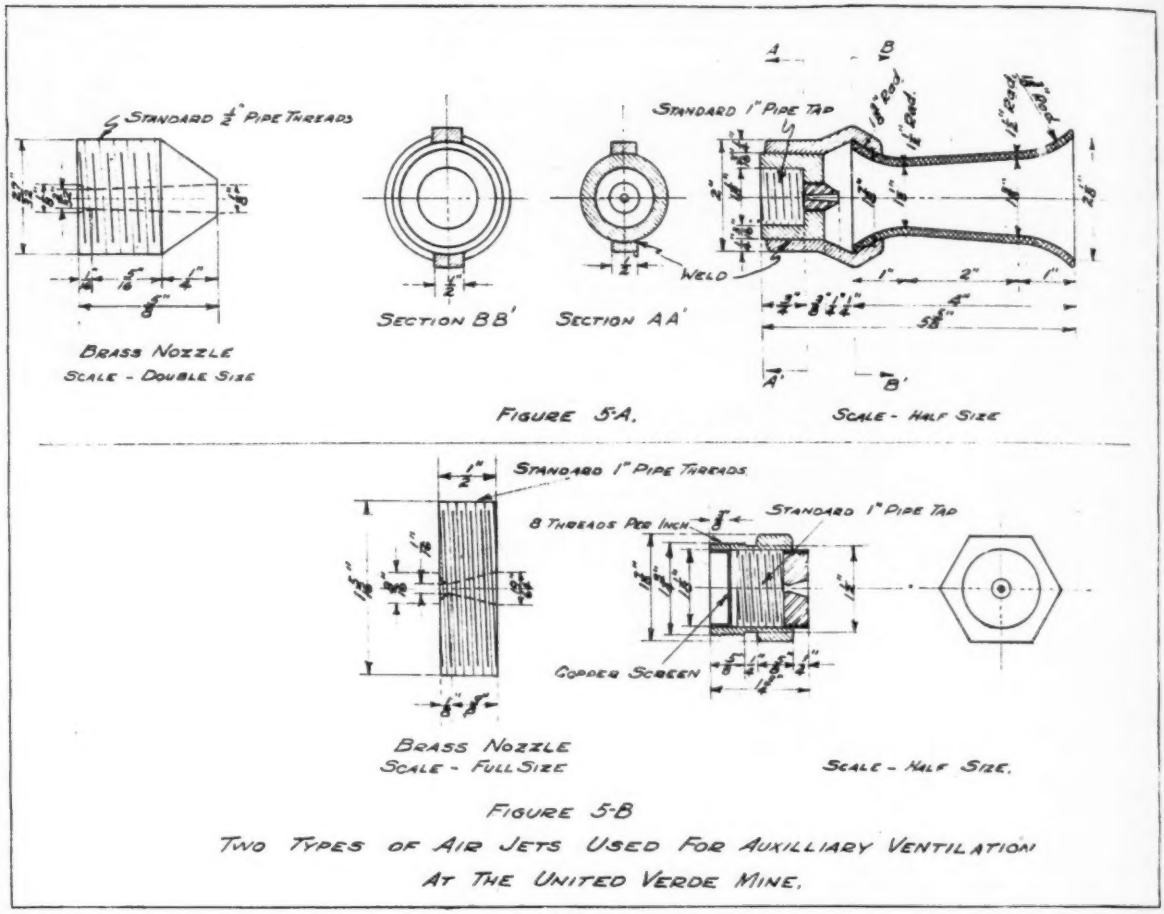


*Figure 5*

No. 250 Coppus air driven Vano blower. The electric driven unit has a lower operating cost and is used wherever it is possible to secure a source of fresh air from the primary ventilating system. The Coppus Vano blower has the advantage of being more easily installed than the electrically driven unit and can be used where electric power is now available. It delivers approximately 70 cu. ft. of high pressure air along with its normal delivery.

Figure 3 shows the capacity of these various units when delivering air through 11-in. and 16-in. pipe. A No. 3 Sirocco, at 860 r. p. m., will develop a water gauge of three inches. This is insufficient for long lines. The Sirocco No. 4, half-width, single inlet will develop about 100 percent more pressure at 1,150 r. p. m. than the No. 3, and will deliver 55 percent more volume. The No. 4 half-width is better adapted to auxiliary ventilation through long lines of tubing and will eventually replace the No. 3 units for use with 16-in. tubing.

### Ventilation Pipe

Two sizes of ventilation pipe are standardized on at the United Verde: 11-inch, 16-gauge galvanized iron, and 16-inch made from 14-gauge iron. The 11-inch size is used in headings up to 500 feet in length, and the 16-inch pipe for distances over 500 feet. Chart, Figure 4, gives the resistance per hundred feet for varying volumes through these two sized pipes.

Ventube in 50-foot lengths is used to deliver the air from the end of the metal tubes to the working face. It is also used on temporary work and in places where the metal tubing would be difficult to install. Galvanized iron pipe is made up in the mine shops at a cost of $1.10 per foot for the 16-inch size and $0.55 per foot for the 11-inch size. These costs compare with $0.66 per foot for 12-inch Ventube. No accurate figures are available on comparative cost of installation, but the cost of installing metal pipe is roughly three times that for the canvas tubing. The use of metal pipe, therefore, is justified only by the fact that it will stand much more abuse underground than the Ventube.

### Use of Compressed Air For Ventilation

The use of compressed air for ventilating purposes is common practice and is necessary in raises and drifts where the heading is not advanced sufficiently to permit the installation of an auxiliary blower. Compressed air as a ventilating medium is very convenient, and unless regulated closely by the bosses the practice is apt to be carried to extremes and either results in high power costs or lowers the air pressure with a resulting lower drilling efficiency.

At this mine approximately 7,500,000 cu. ft. of free air is compressed daily at a cost of $340. Approximately 60 percent of this is unaccounted for and represents leaks and that portion used for ventilating purposes. Possibly 50 percent of this shortage is used for ventilation, and this represents a daily cost of $170.

The following tabulation has been prepared showing the amount of air lost through openings of various sizes and the cost per 24 hours:

| Diameter of Hole | Cu. Ft. Free Air per Min. | Cost Per 8-hour Shift |
|---|---|---|
| 1/64" | 0.364 | $0.01 |
| 1/16" | 5.87 | 0.14 |
| ¼" | 94.0 | 2.26 |
| ⅜" | 211.0 | 5.06 |
| ½" | 376.0 | 9.02 |
| ¾" | 843.0 | 20.23 |

Pressure—90 pounds. Cost per 1,000 cu. ft. free air, $0.05.

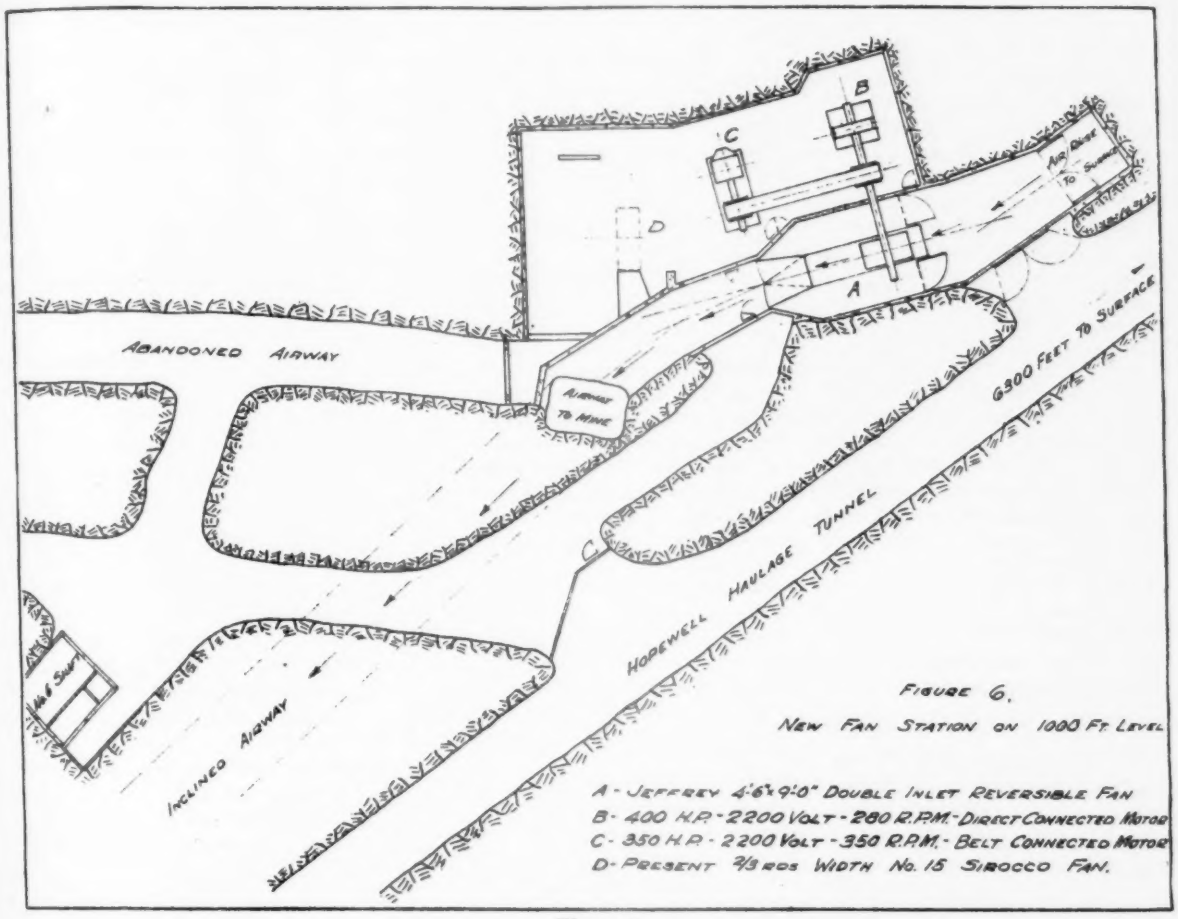
B
C
D
A
ABANDONED AIRWAY
AIRWAY TO MINE
6500 FEET TO SURFACE
HOPEWELL HAULAGE TUNNEL
INCLINED AIRWAY
A - JEFFREY 4'6"x9'0" DOUBLE INLET REVERSIBLE FAN
B - 400 H.P. - 2200 VOLT - 280 R.P.M. - DIRECT CONNECTED MOTOR
C - 350 H.P. - 2200 VOLT - 350 R.P.M. - BELT CONNECTED MOTOR
D - PRESENT 7/3 RDS WIDTH No. 15 SIROCCO FAN.

FIGURE 6.
NEW FAN STATION ON 1000 FT. LEVEL

*Figure 6*

### Air Jet With Manifold

Whenever it is necessary to use high-pressure air for ventilation, an appreciable saving can be effected by the use of an air jet with manifold. A jet, or air injector, of this sort, with a ⅛-in. jet and expansion nozzle will use approximately 20 cu. ft. of free air per minute at 90 pounds pressure, and deliver 800 cu. ft. of air per minute. Although only a small portion of the delivery is fresh air, the greater volume increases the efficiency of a worker by increasing the cooling power of the atmosphere in which he is working. Figures 5-A and 5-B give details of two styles of air jets used at this mine.

Some idea of the cost of compressed air as compared to the jet or blower may be gained from the following tabulation:

| | Power Cost Per Hour |
|---|---|
| 1. 1-in. air hose with valve cracked to use approximately 150 cu. ft. free air per minute | $0.36 |
| 2. Air injector on end of hose using 20 cu. ft. free air per minute | 0.05 |
| 3. No. 250 Coppus air turbine delivering 1,000 cu. ft. air through 500 feet of 11-in. pipe | 0.14 |
| 4. No. 3 Sirocco electric fan delivering 1,200 cu. ft. free air through 500 feet of 11-in. pipe | 0.03 |

It is very evident that where it is necessary to use high-pressure air in a working place the air injector should be used. Wherever a heading has advanced sufficiently, and auxiliary ventilation is needed, the use of an electric fan with ventilation pipe is recommended. The air turbine is used on temporary installations where power lines are not available or where the electric fan would be difficult to install.

### Cost of Ventilation

The following are actual costs for ventilation during the year 1925:

| | |
|---|---|
| Labor | $32,672.93 |
| Supplies | 11,181.46 |
| Electric power | 29,211.66 |
| Compressed air | 11,970.46 |
| Repairs | 17,798.37 |
| Total | $102,834.93 |

The charge for compressed air is a set charge used in blowing, and is taken as the equivalent of 600 machine shifts per month. This represents approximately 10 percent of the total air consumption.

The above expenditures for ventilation converted into unit costs are as follows:

| | |
|---|---|
| Mine tonnage | 960,358 |
| Cost per ton | $0.107 |
| Average number men underground | 960 |
| Cost per man per year | $107.00 |

### Ventilation in Connection with Fire Protection

In addition to the standard mine ventilation door to control the air movements throughout the mine, all stoping areas are provided with doors in the drifts leading to the ore body so that any area may be segregated or cut off from the main air supply in case of fire. These doors are constructed of wood when located in rock headings, or of steel where there is danger of fire from timbered gangways. All doors are provided with latches to prevent them from opening in case the direction of the air currents were reversed.

Certain areas, such as the top slice on the 1,650-level, where there is always the danger of spontaneous combustion, have been further provided with a vertical fire break. This fire break consists of concrete collars and hinged steel doors in all raises leading down from the 1,650-level.

A fire truck, equipped with a No. 425 Coppus air turbine and 500 feet of Ventube is kept in a convenient place at the collar of No. 6 shaft and is used for fire-fighting purposes only.

### Special Problems

#### Present Ventilation Inlet

Under present conditions 40 percent of the air to the fan enters Hopewell Tunnel, which is 6,600 feet long and has a cross-sectional area of 90 sq. ft. The resistance offered to 100,000 cu. ft. of air per minute when the tunnel is open is 0.75 inches. Ore trains in the tunnel seriously interfere with the passage of air in this inlet, the volume being reduced by 50 percent when the trains are going out.

The remaining 60 percent of the air enters the 500 adit, which is 1,600 feet in length and 8 ft. by 9 ft. in section, and thence down No. 6 shaft to the fan inlet. (Refer to Figure 1.) The volume of air through this inlet also varies with the position of the cage in the shaft and the ore trains in Hopewell Tunnel.

#### Necessity for New Fan Inlet

Both tunnels, being of timber construction, are fire hazards and, although the 500 adit timbers were gunited and the fan inlets provided with steel doors so that all the air could be drawn through one inlet in the event of a fire in the other, it is questionable whether or not action in case of fire in either tunnel would be prompt enough to prevent smoke and fumes from being sent to all workings throughout the mine.

Another serious drawback with the present inlet system is that the fan pulls directly on all station doors leading to No. 6 shaft, and this leakage is circulated directly back to the fan. The total leakage of air recirculated to the fan without doing any useful work averages between 20 and 25 percent. This leakage in itself represents an annual power charge of $6,200.

Because of fire hazard, air leakage, and high intake resistance in the present intakes, a new air raise was planned in the early part of 1924. Work was started in August, 1924, and the rock work was finished in February, 1926. The fractured character of the diorite necessitated concreting, and this work was started in February, 1926, and will be completed by February, 1927.

In considering the size and cross-sectional area for the new raise, the square section was chosen in preference to the circular because it worked in better with the standard size cribbing used in raise work, standard stope sets in loose ground, and steel forms used in shaft construction. The following tabulation shows the estimated cost of the raise and the power charges for various sections of raises in comparison to the section chosen, viz, 13 ft. by 13 ft.:

| Size (feet) | Estimated Cost of Raise | | Power Cost Per Year | Total Cost Per Year |
|---|---|---|---|---|
| | Per Foot | Total | Per Year | |
| 11 by 11.. | $60 | $58,000 | $13,800 | $6,900 | $20,700 |
| 13 by 13.. | 70 | 68,000 | 16,100 | 1,700 | 17,800 |
| 15 by 15.. | 81 | 79,000 | 18,700 | 1,500 | 20,200 |
| 11 by 16.. | 71 | 69,800 | 16,400 | 2,800 | 19,200 |
| 11 by 18.. | 76 | 74,000 | 17,500 | 2,100 | 19,600 |
| 11 by 20.. | 80 | 78,000 | 18,500 | 1,600 | 20,100 |
| 11 by 22.. | 85 | 83,000 | 19,700 | 1,300 | 21,000 |

Cost of raise is figured over five-year period with interest and amortization at 6 percent.
Cost of power is taken as 1.75 cents per K.W.H.
Total height of raise—1,000-level to surface—975 feet.

Preliminary plans called for a gunite job, but the ground was fractured and broken up more than anticipated, so that it was necessary to concrete the upper 320 feet solid. This portion is 12 ft. 2 in. by 12 ft. 2 in. in cross section. The walls of the lower section were reinforced with concrete rings 2 ft. 6 in. in depth placed on 7 ft. 6 in. centers. This method of concreting was used in No. 6 shaft construction.

The complete cost per foot of this air raise will average approximately $63 per foot for excavation and $41 per foot for concreting. With a volume of 250,000 cu. ft. of air per minute, the resistance in inches of water will be 1.1 in. The yearly saving in power charges of the new air raise over the old in friction losses will be $4,000, but the fire hazard on inlet air will be entirely eliminated.

#### Present 1,000-Level Fan

The present fan is a No. 15, single inlet, two-thirds width Sirocco, the rotor being 7 ft. 6 in. in diameter and 2 ft. 6 in. wide. It is driven by a 400 h. p., 280 r. p. m., slip-ring motor through a short-center belt drive with a reduction ratio of 1.26. The fan was installed in 1917 when mine-ventilating conditions were not good and the mine resistance was high. For this reason a single inlet, two-thirds width fan was recommended by the manufacturer. The motor was later equipped with a push-button-type control with a bank of resistances in the secondary circuit arranged to give three speeds. Speed control in a fan installation has a decided advantage in that the volume of air may be varied to suit operating conditions. In this mine it is desirable to have a greater volume of air after blasting periods in order to rid the working places of gases. There are also certain periods, such as change day and holidays, when the fan need not deliver the normal volume of air. The loss of power through resistance grids varies directly as the speed, whereas the horsepower varies as the cube of the volume. It is therefore evident that a saving in power can be effected by this type of speed control when normally the fan runs on full speed. The various speeds with the volume and horsepower requirements of the present installation are as follows:

| Speed | Revolutions of fan | Volume Air Delivered | Water Gauge | H. P. Required |
|---|---|---|---|---|
| Full..... | 352 | 200,000 | 4.0 | 500 |
| ¾ ..... | 287 | 150,000 | 2.3 | 320 |
| ½ ..... | 220 | 115,000 | 1.3 | 290 |

According to the present operating schedule, the fan runs 17.5 hours at three-fourths speed, 3.5 hours at full speed, and is idle three hours during each day. On this basis, the power requirements averages 130,000 K.W.H. per month, which at 1.75 cents per K.W. delivered underground, represents a monthly power cost of $2,280.

#### Necessity for a New Fan

In 1921 No. 5 shaft was extended to the 2,400-level, and operations at this extended depth during the following years made it evident that the old ventilating system and the airways would have to be improved if proper ventilation were to be secured below the 2,400-level. In the early part of 1925 a series of tests were made on the present fan installation and it was found that it was operating at the low efficiency of 35 percent. Considerable mechanical trouble was also experienced because of the light type of fan construction and because of its being run at a higher speed than that for which it was designed. A new fan installation was therefore decided on.

#### Selection of New Fan Site

Two locations were considered for the new fan installation; first, at the top of the new air raise mentioned before; and second, an underground installation at the foot of the air raise on the 1,000-level. The installation at the top of the air raise would have been much less expensive than the underground location, but because of its inaccessiblity and possibility of movement of the fractured diorite in the upper portion of the air raise, the underground site was selected.

#### Selection of Fan

Future requirements were placed at 250,000 cu. ft. of air per minute. Because of changes being made in the airways and the fact that the new air raise will eliminate a 20 to 25 percent leakage which now circulates back through the fan, it was difficult to estimate what the mine resistance would be from the tests on the present installation. Specifications were submitted to three representative companies who specialize in mine fans, and it is interesting to note the lack of uniformity in the equipment recommended by them. The following tabulation gives in brief form the main items of the three quotations:

| | Companies | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Volume—cu ft. per minute | 250,000 | 250,000 | 250,000 |
| R. P. M. of fan | 318 | 271 | 245 |
| Mine resistance | 5.3 | 5.3 | 5.3 |
| Brake H. P. at fan | 350 | 310 | 278 |
| Mechanical efficiency (percent) | 75 | ..... | 76 |
| Diameter of rotor (inches) | 90 | 105 | 120 |
| Width of rotor (inches) | 60 | ..... | 48 |
| Total weight (pounds) | 19,000 | 25,000 | 35,000 |

The wide variation in brake horsepower or efficiency shown above can be due to only one thing, i.e., their different estimates as to what proportion of the velocity pressure can be converted into static pressure and considered as useful work.

No. 3 fan was selected because of its heavier construction, very little consideration being given to the power requirements quoted, as these variations were considered more as differences of opinion rather than variations in mechanical efficiencies. The fan is now on hand and will be installed by August, 1927.

### Selection of Fan Drive

Three types of drives were considered in this fan installation:

1. Direct connected, standard slip ring motor with grid resistances to give speed control;

2. Direct connected, brush shifting type motor to give varying speeds;

3. Belt connected slip ring motor run at constant speed.

The first possibility was eliminated because of high power costs. The fan operates at normal capacity 85 percent of the running time and, if normal capacity were at ¾ speed, the motor efficiency would be approximately 65 percent.

The brush shifting motor is often used where speed control is essential. The first cost is about three to four times that of a standard motor, but it has the advantage of a wide range of speed between certain limits. The following tabulation has been prepared to show a comparison between the two drives under alternates 2 and 3:

| Cu. ft. Per Min. | Mine Velocity Ratns. | Mine Velocity Head | R. P. M. | Efficiency Motor | Efficiency Fan | H. P. Input | Hours Per Day | K. W. H Per Day | Cost |
|---|---|---|---|---|---|---|---|---|---|
| **Proposition No. 2—Brush Shifting Motor:** | | | | | | | | | |
| 225,000 | 4.3 | 1.1 | 252 | 77 | 75% | 330 | 17.5 | 4,300 | $75.20 |
| 275,000 | 6.4 | 1.3 | 308 | 80 | 75% | 560 | 3.5 | 1,460 | 25.60 |
| Total air delivered per day—4,900,000 cu. ft. | | | | | | | | 5,760 | $100.80 |
| **Proposition No. 3—Belt connected, constant speed, slip ring motor:** | | | | | | | | | |
| 250,000 | 5.3 | 1.2 | 280 | 90 | 75% | 400 | 21.0 | 6,270 | $110.00 |

Proposition No. 3 was selected for several reasons: first, because with the present mine conditions, it would have been inadvisable to try to force 275,000 cu. ft. of air through the mine workings against a water gauge of 6.4; second, the size of the fan and motor would necessarily have to be increased to take care of the maximum quantity of 275,000 cu. ft.; and third, because two motors of suitable size were already on hand.

It was therefore decided to use the present fan motor, a G-E, 400 h. p., 280 r. p. m., 2,200-volt, 3-phase, 60-cycle, slip ring motor, and direct connect same to fan. In order to use this motor, it was necessary to reduce the fan diameter to 9 feet and increase the width from 4 to 4 feet 6 inches. This motor will be equipped with push button control and resistance grids which are now on the present layout.

Figure 6 shows the new fan layout with respect to the present station. In addition to the direct drive, an auxiliary belt drive is planned. This motor is now on hand and is a Westinghouse, type CW, wound rotor induction motor, 350 h. p., 2,200-volt, 3-phase, 60-cycle, 350 r. p. m. It will only be used as an auxiliary or spare drive in the event of trouble with the direct connected motor, and will also serve as a spare to No. 6 hoist motor, which has the same frame number and is interchangeable. The belt drive will also permit changing the speed of the fan to suit mine conditions as they change from time to time.

### Conclusions

The importance of good ventilation has been recognized for a number of years. Prior to 1924 the ventilation problem was not a difficult one, and very little development was performed for the benefit of ventilation alone. With continued vertical depth, however, the old system proved inadequate and since then approximately $150,000 has been expended on new airways and improving existing ones.

No ventilating system can be expected to work satisfactorily unless the volume of air is distributed properly and delivered when needed. A ventilation engineer has recently been employed for this purpose, and it is felt that a more thorough study of the ventilation problem will lead to added improvements in the future.

## CONSUMPTION OF TIN INCREASES IN UNITED STATES

A NOTABLE increase in the consumption of tin in the United States within recent years is indicated as the result of a special inquiry conducted by J. W. Furness, mining engineer, Bureau of Mines. Returns received from more than 1,100 large consumers of tin show that in 1925 the imports of virgin tin were 76,640 tons, as compared with imports of 69,518 tons in 1917. Reclaimed tin of record in 1925 amounted to 27,632 tons, which compares with a total of 17,320 tons in 1917. A total of 104,272 tons of metal was available for trade consumption in 1925, as contrasted with total supplies of 86,838 tons in 1917. The 1917 figures quoted are taken from a compilation made by the War Industries Board in that year. A careful canvass of the trade showed a total consumption of 117,406 tons of tin in 1925, indicating a consumption of 13,134 tons more than the indicated available supply.

Since 1917 there has evidently been a great increase in the consumption of tin in tin and terne plate, in babbitt, brasses and bronzes, and in solder. Apparently at the end of the war all visible supply of tin was consumed, or in the hands of consumers. Consumers' stocks are an undetermined factor in the supply and may account for more than the 13,134 tons excess of consumption over visible supply in 1925. Unquestionably, however, a part of this unaccounted for metal may be attributed to the short service rendered by the finished article and the rapidity with which it finds itself again in the melting pot; thus the metal may be reused several times during a year. An inference that might be drawn from the study is that the accumulated free stocks of tin are never high.

Babbitt and bearing metals, brasses and bronzes, castings, white metal and type metal are the only uses for tin serving for a short period of time that allow the metal to be reused, but even these uses cause very considerable losses. The metal used in tin and terne plate, solder, foil, collapsible tubes, chemicals, etc., is dissipated for all time.

In 1925 the production of terne plate in the United States was 100,000 tons and that of tin plate 1,550,000 tons. The 1917 canvass showed a production of 75,000 tons of terne plate and 1,425,000 tons of tin plate. The tin used for tin and terne plate in 1925 amounted to 34,481 tons, as compared to 27,600 tons in 1917.

The principal centers of the consumption of pig tin are:

Tin and terne plate, Pittsburgh, Pa.

Solder, Chicago, Ill.

Babbitt, bronze and brass, Detroit, Mich.

Foil, New Jersey, Michigan, Missouri and New York.

Collapsible tubes, Northern New Jersey.

Type metal, Chicago and New York.

Statistics and further detail are contained in Information Circular 6019, by J. W. Furness, copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

# HEAT TREATING ROCK DRILL STEEL*

*The Purpose Of This Paper Is To Discuss The Preparation Of A Straight Carbon Rock Drill Steel In General, And To Describe In Detail The Practice At The United Verde Copper Company And Limitations Of Some Of The Equipment Used*

By W. P. Goss†

As there is an article entitled "United Verde's Drill Shop Practice" in the January 1st issue of The Engineering and Mining Journal, an account of all the details of our practice is not necessary in this paper.

The flow sheet shown in Figure 1 explains the method of routing the steel through the shop. The floor plan in Figure 2 illustrates the arrangement of equipment. The major equipment consists of six Ingersoll-Rand sharpeners and one Waugh Model 8 sharpener, with a home made furnace and punch for each; two Gilman CE-21 automatic heat treating machines; three furnaces used for heating steel for hardening; and a G-E centrifugal blower for supplying air for the furnaces.

The six Ingersoll-Rand sharpeners are used for forming new bits and sharpening steel, and the Waugh sharpener is used solely for forging shanks on the steel. The output per machine averages about 375 pieces of steel sharpened per shift. About 250 shanks formed on 1¼-in. steel, or 350 shanks formed on ⅞-in. quarter octagon steel is a shift's work for the Waugh sharpener.

A concrete floor covered with boiler plate and small flat wheeled trucks make it very easy to move steel about the shop whenever necessary. The steel is handled between the working places in large trucks which run directly on to the mine cages, so that unnecessary handling is avoided.

The furnaces are made in our shops and have proved very satisfactory. They are equipped with Gilbert & Barker 1½-in. single jet burners, with special air orifice. The oil used is a semi-Diesel fuel oil with a gravity of 24° Baume. The consumption is about 3 gallons per hour. The air is used at 1.25 lbs. pressure, and the line from the centrifugal blower is cross-connected with the high pressure line from the main compressors so that either source may be used when necessary.

The shop has a capacity of 2,500 pieces of steel per 8-hour shift, but at present it is working one shift only with a daily output of 1,800 to 2,000 pieces of steel. As there are 24 men working in the shop, including the boss, the output per man is about 80 pieces per shift.

Our consumption of drill steel last year was about 101 tons, but this was a little lower than usual. We find it necessary to keep about 28,000 pieces of steel in circulation, due to the large number of working places we maintain and to the exceptionally hard rock encountered in some places. As many as 250 pieces of steel may be required to drill a 20-hole round four feet deep.

The costs for handling and treating the steel are as follows:

| | Per Piece of Steel | Per Ton Ore Mined |
|---|---|---|
| Nipping | $0.009 | $0.004 |
| Labor (Sharpening, Hardening) | 0.063 | 0.031 |
| Oil | 0.006 | 0.003 |
| Air | 0.017 | 0.008 |
| Repairs | 0.040 | 0.020 |
| Miscellaneous supplies | 0.005 | 0.002 |
| Total | $0.140 | $0.068 |

## Forging

The first operation in the preparation of drill steel is the heating of the steel for forging. This applies whether it be a piece of new steel or a piece which has been in use. The steel should be placed in the furnace so that four inches of the bit end will be heated to 1,900° F., if a bit is to be forged, or so that six inches of the shank end will be heated to 1,950° F., if a shank is to be forged. The furnace should be constructed and the fire regulated so that a cold piece of steel will be heated to 1,900° F. in ten minutes. If the hearth is 30 inches long, the furnace will have a capacity of 90 pieces of steel per hour, which is sufficient to keep any sharpener supplied.

The temperatures given above are higher than those recommended by many authorities and they are not the best temperatures to employ if we were concerned only with producing perfect steel regardless of cost. However, they are about the nearest to the theoretical "best temperature" that we can use and still have reasonable production costs. It is true that the hotter the steel comes from the furnace, the easier it is to forge, and thus the output per man increases and the maintenance on the sharpeners decreases. Nevertheless, these advantages are offset by a poor product and a short furnace life. Drill steel obtains its finest structure at a temperature between 1,400° and 1,475° F., depending on the carbon content. As it is heated above 1,475°, the grain coarsens and the steel weakens or becomes lower in tensile strength. The change in structure is not very harmful until the steel has been heated to 1,800° F. As the temperature is increased above 1,800° F., the structure weakens rapidly until at 2,200° the steel is almost worthless, while at 2,400° it is so badly burned that it cannot be hardened.

If drill steel which is heated to more than 1,475° F., is hammered, the coarse grain will be refined and the steel toughened. It is this property of the steel which permits it to be heated to 1,900° or 1,950° F. without causing undue weakness, for the hammering it receives in the sharpener refines the grain and strengthens the steel. This does not mean that hammering is a "cure all" for overheating, as it is impossible to entirely refine the grain of the overheated steel.

Hammering refines the grain only while the steel has a temperature above its upper critical range. This is 1,475° for most drill steel. If the steel is hammered after it has cooled below this temperature, as shown by a medium red color, strains and cracks will appear in the steel so that it will fail when put into service.

It should not be necessary to maintain a furnace temperature of over 2,000° F. This temperature will not burn the steel unless it is left in the furnace for a long time, and it is low enough so that a good fire box will last several months.

There should be some accurate method for determining high temperatures in every drill steel shop. At least the man in charge should know at what temperature his steel is being forged. It is all very well to speak of such temperature colors as "cherry," "salmon," "orange," or "lemon," and the experienced heat treater understands their meaning and approximate values, but the average man available for operating a drill sharpener and forging furnace knows nothing about color or temperature. As an instance of this, one side of our sharpening shop is exposed to the afternoon sun, which may shine directly into some of the furnaces. Formerly operators on this side of the building invariably complained that the steel was coming from the furnace too cold to work, when it was actually above 2,000° F. They could not comprehend that the color of the steel depended on the light and that a light yellow in moderately diffused daylight would turn to a red in direct sunlight. To overcome this "mental hazard," the steel foreman had all the windows on that side of the building painted green.

* Paper presented to Annual Meeting, Arizona Chapter, The American Mining Congress.
† Chief Efficiency Engineer, United Verde Copper Company, Jerome, Arizona.

The general dimensions of the forging furnace used at the United Verde are shown in Figure 3. The fire is regulated so that the temperature at the hot end of the furnace is about 2,000° F. This temperature is indicated on a pyrometer attached to the furnace. The thermocouple is inserted in the end of the furnace so that it is close to the piece of steel ready to be forged. The pyrometer only indicates the temperature of a small volume of hot gases surrounding the end of the thermocouple, but, with other conditions remaining constant, the difference in temperature between the thermocouple and the steel is constant over a range of several hundred degrees. Under our conditions of operation this difference is approximately 100° F.

The length of time that the steel is in the furnace is an important point to consider. If it is heated too quickly, the outside will heat up to much faster than the inside that cracks may be induced due to unequal expansion. Also the outside may appear to be hot enough to forge when the inside is too cold. If the steel acquires a temperature of 1,900° F. in 10 to 12 minutes, no harmful effects can be noticed.

To prevent decarburization, drill steel should be heated in a reducing or a neutral atmosphere. This can be accomplished by regulating the fire so that there is an excess of carbon in the flame, or by heating the steel in a closed muffle furnace. We are experimenting at the present time to determine, by microscopic inspection and chemical analysis, the effect different furnace conditions may have upon the composition and carbon content of drill steel.

After the steel is heated to the required temperature, a bit or shank is forged on it. A longer time is required to forge a shank than to sharpen a bit, but the same principles apply to both operations. The principal reason for overheating drill steel is so that the forging may be accomplished from one heat. A new bit can be forged from one heat if the original temperature is 2,200° F. At 1,900° F. a skillful operator can forge a new bit from two heats, and at 1,800° F. four heats are required.

The bit and shank should be formed as nearly perfect as possible if a maximum amount of work is to be accomplished. A shank may be too long or too short, and either fault will decrease the power of the stroke of the machine drill piston. If the diameter of the shank is too large, it will stick in the chuck of the machine, and if the diameter is too small the steel will vibrate in the chuck, causing breakage and undue wear. The double taper, 4-point cross bit is designed to ream as well as shatter the rock. If one wing is shorter than the others the work will not be evenly distributed and the bit will not cut as fast or as far as it should. If the taper is not put on uniformly, the same thing will occur. If the cutting edges are not sharp, the bit will not cut as fast as it should. If the gauging is done inaccurately, the miner will have trouble with stuck steel.

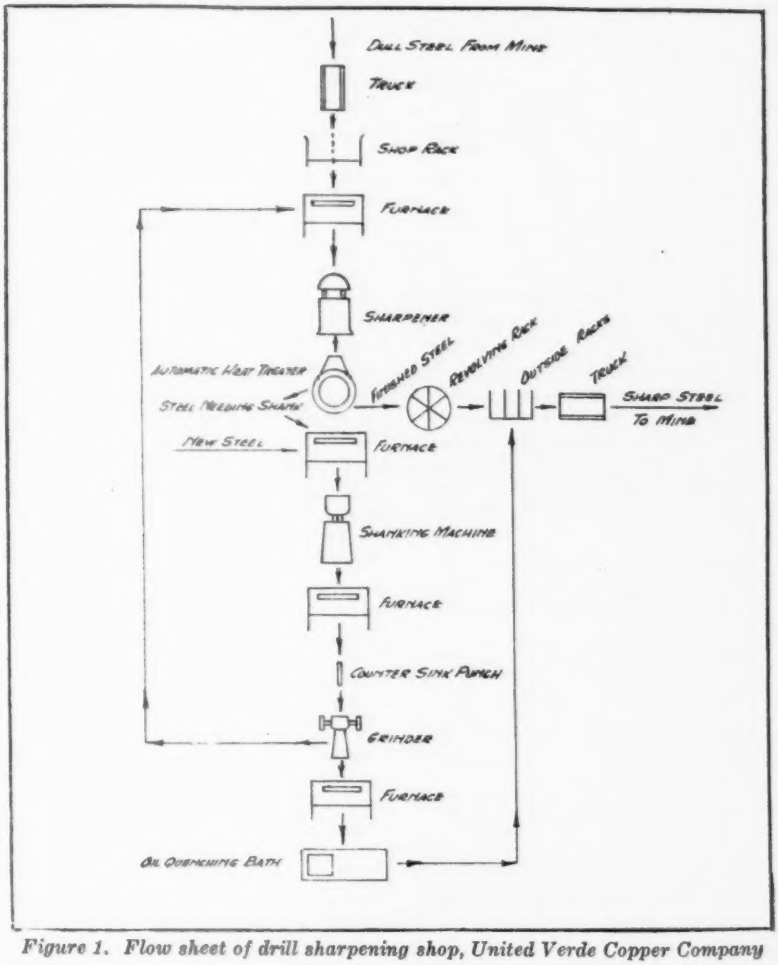


*Figure 1. Flow sheet of drill sharpening shop, United Verde Copper Company*

The dollies, dies, and fuller blocks which we use are made in our machine shop from Firth Sterling Special steel at a considerable reduction in cost over the factory product. They are hardened by very slowly heating them to 1,700° F. and then quenching them in oil. These tools will sharpen about 7,000 bits before they require rebuilding. Our costs are made up as follows:

| | Dollies-Each 1⅝"-2" | Dollies-Each 2 1/16"-2¼" | Pair Fuller Blocks | Pair Dies |
|---|---|---|---|---|
| Machine Labor | $1.83 | $1.83 | $3.95 | $4.37 |
| Machine Overhead | 0.69 | 0.69 | 2.01 | 2.19 |
| Tempering Labor | 0.10 | 0.10 | 0.45 | 0.45 |
| Tempering Overhead | 0.04 | 0.04 | 0.24 | 0.24 |
| Material | 2.79 | 4.14 | 4.43 | 8.30 |
| Total Cost | $5.45 | $6.80 | $11.08 | $15.55 |

All of these faults can be avoided by the use of careful workmen and by keeping the machines in proper condition. The dolly and dies must be kept in alignment. Dollies, dies, fuller blocks, and gauging blocks wear quickly. For this reason they should be inspected regularly and kept in good repair. The operator cannot produce good shanks or bits with poor tools, no matter how careful he may be.

From the foregoing discussion of forging drill steel it is evident that the steel may be ruined before it gets to the heat treater. I wish to emphasize this point, for it is common practice to lay the blame for poor steel on the heat treater. If the steel has been burned, or hammered after it is cold, no heat treatment can repair the damage. If a misshaped bit or shank has been formed, the steel is not worth heat treating.

### Hardening Shanks

After the steel has been forged it should be allowed to cool in the air to atmospheric temperature before treating

it further. Many steel companies recommend that the steel be normalized after forging, that is, reheated to about 1,800° F. and allowed to cool in air. This operation relieves the strains and stresses which were set up in the steel when it was forged. Theoretically, this is good practice, but we have never checked its practical value. Its adoption in our shop would necessitate two more men and two more furnaces; also, more steel would be in circulation than we now have, for it would take longer for a given quantity of steel to pass through the shop.

The face of the shank should be ground square, the hole countersunk, and the edges chamfered before it is hardened. These operations insure a proper striking surface for the machine drill piston to work on and removes sharp edges around the hole which might cut off the water needle.

Shanks may be hardened in water or oil, but if they are hardened in water they must also be tempered or drawn; otherwise they will be too hard. It requires more skill to harden and temper shanks in water than it does to harden them in oil and so, with the average workman available, the results obtained will be more satisfactory if oil is used as the quenching medium.

As a shank and machine drill piston must work together, it is desirable that one be softer than the other in order that the wear and breakage will not be abnormal. The piston is much more valuable than the shank, therefore, the shank should be softer than the piston. A shank should be as tough as it can be made and have only enough hardness to prevent upsetting during the life of the steel. Pistons vary in hardness according to composition and heat treatment, but most of them have a hardness of from 600 to 650 Brinell. A shank with a hardness of from 350 to 400 Brinell will work well with any good piston and, if it has been heat treated properly, it will not upset or spall.

The shank of the steel should be treated for an inch or two beyond the collar or lugs preparatory to hardening. This is especially important if the steel has not been previously normalized, as it will help greatly to remove forging strains set up when the shank was formed. The heating should be done slowly in a furnace which has the same temperature as that desired for the steel.

It is generally recommended that shanks be heated to 1,500° F. for quenching in oil. This is the minimum temperature at which a perfect shank can be sufficiently hardened in oil. It is therefore not a practical working temperature since a large percent of the shanks turned over to the heat treater are not perfect. Also some variation in the temperature of the shanks must be allowed, for it is impossible to thoroughly saturate every shank with heat at exactly 1,500° F. As a result shanks which have been overheated in forging and those which have been quenched before they are thoroughly heated to 1,500° F. will fail when put into use. By increasing the quenching temperature to 1,600° F., a shank can be produced which is practically as good as those quenched at 1,500° and the following benefits are a result. Shanks which have been overheated in forging will be better than if they were quenched at 1,500° and a temperature of 1,600° will make it practically certain that all of the shanks will be heated above 1,500°. Also, 1,600° F. is not the maximum temperature at which good shanks can be made, so that no harm is done if some of the steel is heated above this figure. Ingersoll-Rand "Sandvicken" drill steel has a carbon of about .85 percent and shanks from the ⅞-in. quarter octagon section of this steel show approximately the same Brinell hardness when quenched in oil from temperatures varying from 1,500° to 1,800° F.

The oil used for quenching should not be allowed to reach a temperature above 100° F. This can be accomplished by the use of a large volume of oil in comparison with the amount of steel quencher, or by cooling the oil in some mechanical manner. Our practice is to quench the shanks over a bubble of oil in a tank which has a capacity of about 65 gallons. The oil is kept circulating through coils of pipe immersed in running water. We use Houghton No. 2 soluble quenching oil and our results have been very uniform. If cyanide is used to form a hardened film on the shanks, the No. 2 oil coagulates in time; therefore, the Houghton Company make a No. 3 soluble quenching oil which will act the same as No. 2, except that it will not coagulate under the action of cyanide.

A screen should be placed a few inches above the bottom of the oil quenching tank so that the steel does not rest in any water or other foreign matter which may collect in the bottom, and the tank should be cleaned out at regular intervals in order to remove such an accumulation from the bottom.

Drill steel shanks which are too soft will upset when put to work and spall or stick in the chuck. A stuck steel puts the machine out of commission for the shift and a spalled shank will ruin a piston which is valued at $20.00 to $30.00. If the shank is too hard, it will "cup" the face of the piston, or the corners will break off and chip or break the piston. However, upset or chipped and broken shanks do not necessarily imply that the shank was not good, for a "cupped" or broken piston will ruin a shank very quickly.

Some system of inspection should be maintained in order that the poor shanks will not get back into service after the steel has been brought to the shop. Shanks which are only slightly burred may be redressed on an emery wheel, but badly upset or broken shanks should be cut off from the steel. It is poor practice to attempt to reforge a bad shank, because if the trouble was due to the steel being burned originally, subsequent treatment will not help and, in any case, folding under the broken or burred edges on the face of a shank will leave planes of weakness so that the shank will soon fail again when put to work.

### Hardening Bits

To correctly harden drill bits is a difficult problem. The wings of the bit are so thin and the cutting edges are so sharp in comparison with the shocks and abrasion to which they are subjected that only slight tolerances are allowed in the heat treatment if the bit is to do a maximum amount of work. The treatment the bit receives should depend on the composition of the steel and on the character of the rock to be drilled. The only satisfactory way to determine a suitable treatment for a given set of conditions is to experiment until a bit is produced at a reasonable cost which will show a minimum amount of wear and no chipping or flattening. The experimenting is usually done with a small amount of steel which has been very carefully treated. Therefore, after an ideal procedure has been worked out, there is still the problem of adapting this procedure to the shop practice so that a majority of the bits treated will be hardened correctly.

The best drilling results could probably be obtained by heating the bits slightly above the critical temperature, quenching in water, then drawing or tempering them according to the character of the rock to be drilled. Most mining companies consider this double treatment impractical and so the bit is usually hardened without tempering. Drill steel has the finest structure possible if it is quenched in water or brine from a little above the critical temperature, and this is the treatment generally recommended for the bit. For drill steel having a carbon content of .85 to .90 percent, the critical temperature is considered to be 1,420° F., and the quenching temperature recommended is 1,440° F. Such a treatment will give the best results possible in some kinds of rock, but in other rock a bit so treated will chip and fly to pieces because it is too hard and brittle. A bit which cuts very slowly through the fine grained diorite encountered in our open pit will drill 12 to 18 inches before it is badly dulled and the same bit will cut rather quickly through our massive sulphide rock, but only for two or three inches, then it will be either too dull or too badly broken to drill further.

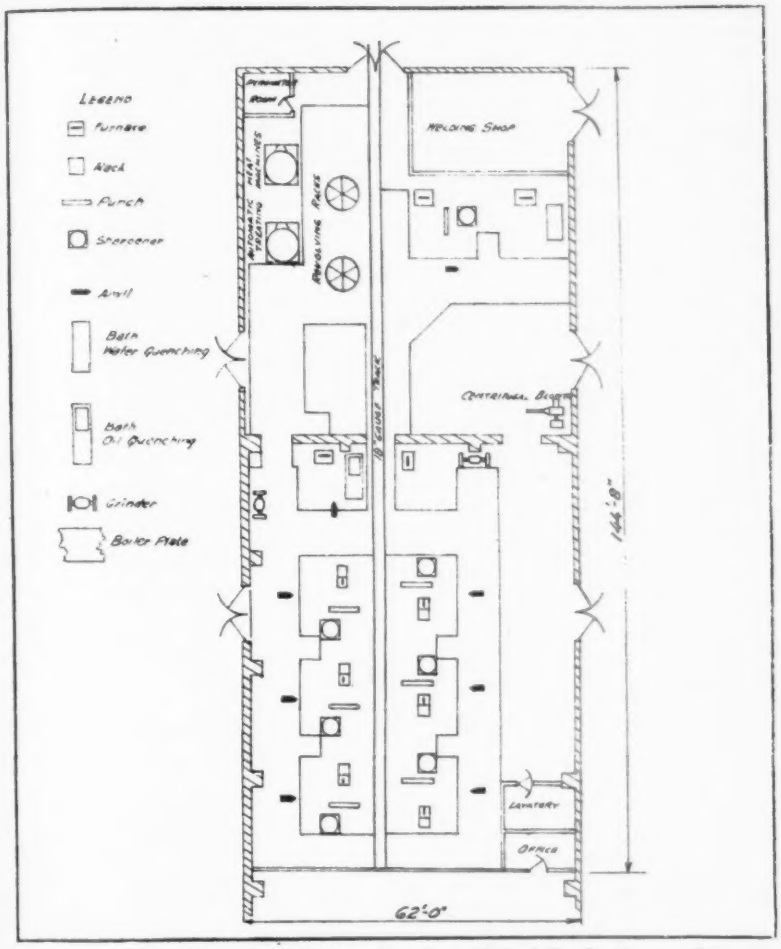


*Figure 2. Floor plan—Drill sharpening shop, United Verde Copper Company*

If very hard rock is to be drilled and it is impractical to temper the bits after hardening them, then they should be quenched at some temperature below the upper critical temperature. We have found that the best results are obtained with Ingersoll-Rand "Sandvicken" steel in our ground if the bits are quenched at 1,375° F. This temperature is too low for practical use, as it is too near the minimum; therefore, we attempt to harden at 1,400° F. It is better to have the bits a little too hard than it is to have them too soft, for a soft bit will not cut at all and it may swell so badly that it cannot be removed from the hole, while on the other hand a hard bit will chip and break, but will drill a short distance and will not stick in the hole.

Most of the bits at the United Verde (about 1,500 per day) are hardened on Gilman CE-21 heat treating machines. We attempt to heat the bits in this machine to 1,400° F. before they are quenched. A thermocouple is placed in both ends of the furnace so that the temperature can be kept constant and, as the speed of the machine is variable, the larger bits may be kept in the furnace longer than the smaller ones. By properly regulating the speed of the machine and the temperature of the furnace, a fairly uniform product can be obtained. We have two of these machines in operation and as their combined capacity is not great enough to handle all of our steel, the balance is hardened by hand in an open furnace similar to those used for heating the steel for forging.

The principal points which I wish to bring out in the above discussion are:

Poor drills may be due to overheating before forging, improper forging, or wrong heat treatment; the hardening treatment which a steel receives should fit the composition of the steel and the character of the rock to be drilled; many of the recommendations of drill steel manufacturers and metallurgists for the treatment of steel are either impractical or incorrect as far as mining conditions are concerned.

### Testing Equipment

A certain amount of equipment is needed if any knowledge of what is being done in the drill shop is to be obtained or if any experimenting is to be done. The quantity and kind of equipment will depend on the accuracy desired and on the amount of money to be spent. Therefore, a color-temperature chart and a file may suffice for some properties, while others may have pyrometers, electric furnaces and machines for making hardness, tensile, and impact tests. If an accurate means of measuring temperatures is available, the mine itself furnishes the best means for testing the drills.

The United Verde has a considerable amount of special equipment for insuring a good product from the drill shop. This is necessary because of the unusually severe drilling conditions encountered in the mine. At many properties very little attention is paid to the drill shop practice and large variations in treatment are allowed because the rock is so soft that almost any kind of drills will apparently give good results. It would very probably be a waste to spend much money in experimenting with the heat treatment under such conditions.

### Pyrometers

All of the furnaces in our sharpening shop are equipped with pyrometers which have proved very valuable in heating the drill steel for both forging and hardening. On the forging furnaces they furnish a check on the temperature so that the steel will not be overheated. On the hardening furnaces they furnish a means of measuring the temperature of the steel so that it may be quenched at the proper heat.

The pyrometers which we use are sold by the Brown Instrument Company, of Philadelphia, Pa. They are Model No. 101-1, with wooden protecting case and the thermocouples are type MA, ⅛-in. by 12-in. with nickel chromium protecting tubes. Pyrometers and thermocouples are of no use unless there is some means available for checking their accuracy, since the couples will deteriorate with use and the pyrometers will vary in their reading according to atmospheric conditions. The instruments that we use are supposed to contain a device for automatically compensating for changes in temperature at the cold junction of the thermocouple, but rapid or extreme changes in atmospheric temperature affect the pyrometers so that they indicate inaccurately. Two instruments placed side by side and attached to the same thermocouple may read exactly the same during the morning and in the afternoon they may show a difference of 25°. The pyrometers on our heat treating furnaces are checked once and sometimes twice a day.

Our apparatus for checking this equipment consists of a Brown Precision Potentiometer, a type QR 12-in. platinum thermocouple, and an electric muffle furnace, 12 inches long by 5 inches wide by

4 inches high. The potentiometer is used for checking the pyrometers and the platinum couple is used for checking the base metal couples used in the furnaces. The electric furnace furnishes a constant temperature for checking the thermocouples. Also, it is very useful in heating steel when especially accurate results are desired for experimental purposes.

A pyrometer is a very valuable instrument when it is used correctly and when its limitations are understood. The reading indicated by the pyrometer is the temperature of the point of the thermocouple and nothing more. Therefore, when a thermocouple is placed in a furnace, the pyrometer indicates the temperature of only a small portion of the furnace near the end of the couple, and the balance of the furnace may be hotter or colder than the pyrometer indicates. Also, a uniform temperature may be maintained throughout the furnace, but a piece of steel in the furnace may have a different temperature than that indicated by the pyrometer. The temperature conditions within a furnace, the type and size of furnace, the mass of steel, and the element of time all influence the temperature of a piece of steel in that furnace, so how can a pyrometer be expected to record the summation of all these effects? Judgment and skill are necessary for the proper use of a pyrometer as with any other tool, and this is best acquired from experience.

### Brinell Harness Tester

The most common type of hardness tester and one which is used in practically all blacksmith shops is a file. This may be fairly accurate when in the hands of an experienced man, but its use depends entirely upon the judgment and memory of the user.

We use an Improved American Model Brinell hardness tester, sold by the Scientific Materials Company, of Pittsburgh, Pa. The Brinell method of testing hardness is based on the theory that hardness is the property of resisting penetration. The test is performed by pressing a steel ball 10 millimeters in diameter, under a load of 3,000 kilograms, into the surface to be tested. The load, 3,000 kg., divided by the spherical surface of the impression, expressed in square millimeters, gives the Brinell hardness number. The diameter of the impression is measured under a microscope and from this figure and the diameter of the ball, the spherical surface of the impression can be computed. Convenient tables have been computed and printed which give the Brinell hardness numbers for every five hundredths of a millimeter change in diameter of the impression from two to seven millimeters.

The Brinell test is a measure of the hardness of the surface tested and it tells nothing about the hardness of the interior. However, it serves a useful purpose in the drill steel shop, for it furnishes an accurate means of determining variations in the heat treatment as reflected by variations in the hardness of the bits and shanks. It is our practice to take periodic samples of the bits and shanks and determine their hardness on the Brinell machine. We allow a variation of from 340 to 387 in the Brinell hardness of our shanks and 550 to 600 in the Brinell hardness of our bits. We also use the Brinell machine for determining and checking the hardness of various tools that we purchase, such as rock drill parts, axes, and shovels.

### Gilman Heat Treating Machines

As stated above, we use two Gilman heat treating machines for hardening bits. The furnaces have a thermocouple in each end and the fire is regulated so that the temperature at each couple is the same. When this condition exists the temperature is fairly uniform throughout the length of the furnace. It is difficult to maintain a constant temperature uniformly throughout the furnace and it requires close supervision on the part of the operator. In the morning the flames heat up unevenly, especially if the night was cold, and then during the day changing atmospheric conditions may affect the operation of the furnaces. Nevertheless, it is possible to operate the Gilman machines in such a manner that practically all of the bits will have the same temperature.

These machines are not foolproof and they cannot be operated to the best advantage by unskilled or careless men. We employ three men to operate the two machines. Two of these are unskilled and they simply put untreated steel into the machine and take away the finished drills, but the third man is occupied with trying to maintain uniform and constant temperatures in the furnaces. The shop boss checks the work of the machines several times a day by testing the hardness of bits taken at random. He also checks the pyrometers.

The furnace on the Gilman machine does not heat a bit uniformly, with the result that the part towards the back of the furnace has a lower temperature than that towards the front. Therefore, one side of the bit is nearly always softer than the other. We helped this condition considerably by removing the stacks from the furnaces and sealing the vent.

The principal advantages of the Gilman heat treating machines at this property are, their average product is better and more uniform than we had been able to obtain from hand treating, and an intelligent man can be trained to get fairly good results from the machines within a few weeks.

The principal disadvantage is that it costs a little more to harden a bit in the Gilman machine than it does to harden it by hand.

We can recommend the use of these machines at any property where more than 1,000 bits per day are hardened and where the character of the ground is such that the best bits obtainable are needed for drilling the rock.

General Data on Gilman Machine:
Oil used.....20 gals. per 8 hours
Air consumption 45 cu. ft. per min. @ 1 lb. pressure
Power consumption.....2.5 K. W. H.

### Choosing a Brand of Drill Steel

The most commonly used rock drill steel is what is known as a straight carbon steel. An average analysis of such steel would be: Manganese, .2 to .35; silicon, .03 to .15; phosphorous and sulphur, less than .03; and carbon, .65 to .95, depending on the brand. In addition, there are various "alloy" drill steels, such as "vanadium" steel, "tungsten" steel, and "molybdenum" steel. The alloy steels are claimed to be superior to the carbon steels, and consequently they are more expensive.

It should be profitable for a property having only a small supply of drill steel on hand to determine whether or not an alloy steel would be most economical for their conditions. However, the results obtained with the alloy steels where they have been used do not seem to warrant their adoption by companies having a large supply of carbon steel on hand. The reason for this is that the alloy steel should be heat treated in a different manner from carbon steel and it would be expensive to keep the two varieties of steel separate. As we have over 200 tons of carbon drill steel on hand, we do not think it would pay to consider a steel which would require a change in our heat treating practice, and on this account only carbon steel was considered in a test made to determine the most economical brand to steel for our conditions.

In the manufacture of drill steel certain desirable properties are obtained only at the expense of others. A steel which offers a maximum resistance to breakage will not hold a cutting edge as well as a steel which breaks more readily. The life of the steel and its ability to hold a cutting edge also depends upon the type of machine in which it is used and on the type of rock being cut. Therefore, the best method for testing drill steel is to put it into use where the conditions are representative of those throughout the mine.

When comparing two kinds of steel it is a fairly simple matter to measure the

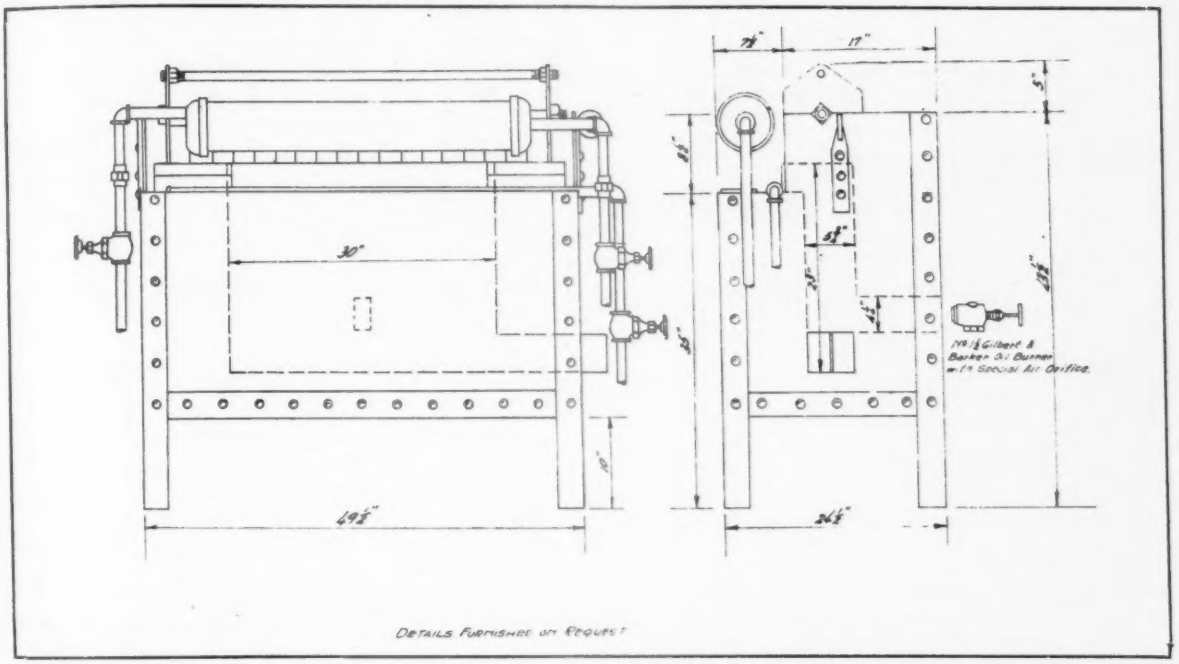


*Figure 3. Furnace for Drill Sharpening Shop*

life or resistance to breakage, the drilling speed, and the wear. However, it is not so easy to evaluate these measurements in terms of cost per unit of work done. As a result most mining companies ask for bids from several reputable manufacturers and choose the cheapest steel which is offered. Other companies make an arbitrary comparison, such as the "block test," and choose the steel which combines good results in such a test with a fair price. Such a practice is dangerous, for it is possible to make a drill steel which will give excellent results with a single type of test, but which will be very uneconomical in service. For instance, a steel with a low carbon content will give excellent results in a block test, but will not hold a cutting edge when drilling hard rock. Moreover, the shanks are apt to upset in the machine.

The block test consists of pounding a piece of drill steel against an iron block until the steel breaks. The life of a piece of steel in such a test is supposed to be indicative of its life in service. Usually a machine drill is mounted in front of an iron block and the block is drilled with the piece of steel which is to be tested. The length of the steel is generally from four to six feet, and it has no bit. As no attempt has been made to standardize the block test, the numerical results obtained at one property or factory cannot be compared with the results at another property. For example, in a block test on 11 brands of steel at this property none of the steel had a life of 60 minutes, yet some of the same brands of steel showed a life of over 100 minutes at two other properties. The machine drill used, the air pressure, the length of the test piece, the mass of the block, the method of cranking the machine against the steel, and the manner of anchoring the machine and block all affect the life of the steel in such a test.

In our test we broke samples of the steel against the block and then drilled about 2,000 inches in the mine with each brand of steel. Drilling speed, depth drilled per steel, gauge wear, and the drilling and sharpening losses were measured for each brand of steel. The results of this test showed that for the 11 brands under consideration there was only a slight difference in drilling speed, penetration and gauge wear, but there was a considerable difference in breakage, drilling and sharpening loss, and shank failure between the various brands. In a general way, the steel which had less than .75 percent carbon showed a long life, but the bits dulled quickly and the shanks upset during the test. Steel which had more than .75 percent carbon broke easily, but the bits held their edges well and the shanks remained in good condition. The breakage in service checked the results of the block test, that is, the steel having the longest life in the block test had the least amount of breakage underground, and the steel having the shortest life in the block test had the greatest amount of breakage underground.

The basis taken for comparing the different brands of steel was pounds consumed per day. The breakage, drilling, and sharpening losses were measurable in terms of pounds, so that it was a simple matter to compute the quantity of steel we would consume per day for each brand due to these losses. The drilling speed and penetration measurements were reduced to pounds by first computing what our cost for labor, actually used for drilling, would be for each brand, and then reducing this cost to its equivalent value in pounds of steel. A number was thus obtained for each brand of steel, and these numbers were proportional to what our drill steel cost per ton of rock broken would be if we were using the various brands. Therefore, if these numbers were multiplied by the cost of the steel per pound, the results would give the comparative cost per day for the various brands of steel. These costs would be numerically inaccurate, but the differences would be very nearly correct.

The value of the tests and experiments we have performed and the effort we are making to produce good steel can be illustrated by the following figures:

| Year | Tons Rock Broken Ugd. | Drill Shifts | Lbs. Steel Consumed | Lbs. Steel Per Ton | Lbs. Steel Per Drill Shift |
|---|---|---|---|---|---|
| 1924 | 1,124,000 | 39,118 | 365,394 | 0.325 | 9.34 |
| 1925 | 1,006,000 | 41,016 | 230,317 | 0.229 | 5.61 |

We have reduced the pounds of steel used per ton of rock broken underground from 0.325 in 1924 to 0.229 in 1925, and this amounts to $0.012 per ton, or about $12,000 per year. Some improvement was made in 1926 over 1925, so that the drill steel consumption was reduced still further.

# THE NATION'S VIEWPOINT

*A Digest Of The Expressed Opinions Of Leaders In American Affairs*

THE amendment to the first deficiency appropriation bill, introduced by **Senator McKellar,** Tennessee, providing for the review by the Comptroller General of refund claims in excess of $50,000 allowed by the Commissioner of Internal Revenue, has occasioned lively debate in the Senate on the efficiency of the bureau's administration and the Government's treatment of taxpayers under the present internal revenue system. Senator McKellar, in justifying the amendment, said that:

"Virtually without any information, the Senate is called upon to authorize the Secretary of the Treasury to refund $175,000,000; that the hearings before the House Committee disclosed that the enormous sum of $21,000,000 is to be paid out to five taxpayers upon the certificates of clerks in the revenue office.

"It seems to me it is little short of the most willful extravagance of the peoples' money. * * * In 1917, the total refund was $887,000; in 1918, it was $2,088,000; in 1919, $8,654,000; 1920, $14,000,000; 1921, $28,000,000; 1922, $48,000,000; 1923, $123,000,000; 1924, $137,000,000; 1925, $150,000,000; 1926, $174,000,000; and for the first three months of 1927, $32,000,000 more. * * * At the present time our refund for 1927 and 1928 just about equals the amount of back taxes that were collected. In other words, with all of our machinery for the collection of back taxes, going back four years as it is now, and five or six years previous to that, we are now collecting just barely enough to pay the enormous refunds made year by year, and if these refunds continue to amount in the way they are doing I do not know whether we can levy enough taxes to pay the refunds in such enormous amounts."

The opposite view was taken by **Senator Warren,** Wyoming.

"The proposed amendment," said Senator Warren, "seeks to change altogether the mode of procedure in the Internal Revenue Bureau. The law as it stands makes no distinction as to individuals or corporations in the manner of paying their income taxes, except, of course, the statute provides different rates of taxation according to the amount of income. The large amount proposed to be refunded under this bill is not the money of the United States; it is simply the money of the taxpayers which, in a certain sense, has been loaned to the United States. It is a forced loan which we are about to return. Provision is made for its return, and the method of procedure is set forth. The United States is satisfied, the individuals are satisfied, and Congress should be satisfied with the adjustments which have been made."

*N. Y. Evening Post*

*Overloaded*

Charging corruption on the part of Treasury officials, **Senator Couzens,** Michigan, stated that his report to the Senate on the investigation of the Bureau of Internal Revenue proved conclusively his charges.

"It is the system which creates all the dishonesty, all the fraud, and all the crookedness in the Bureau of Internal Revenue. There is not any question but that there is favoritism and that employes are taken out and bought a drink and a dinner to influence favorable opinions in cases pending before the bureau for tax refunds. Not only that, but the meetings are held in secret.

"Jeopardy assessments are made, and when the taxpayer submits the jeopardy assessments may be removed, all behind closed doors. The taxpayer may even get a refund secretly after having submitted to the dictates of the Treasury Department."

Senator Fess, Ohio, deplored insinuations that favoritism is being shown taxpayers, and he opposed the proposed limitation upon the Commisisoner's authority to make refunds when it was found taxes had been illegally collected. He said:

"I thought every member of the Senate would be in favor of so simplifying the tax laws that there would not be any taxes illegally collected. The fact is, however, because of the complication of the law and the ease with which the taxpayer can refrain from bringing to the open sources of taxation, that a tremendous amount of back taxes have been collected; and even in the last year vastly more back taxes have been collected than taxes illegally collected. So, as it appears without controversy that taxes were and are being collected illegally, these taxes ought to be refunded as soon as it is demonstrated that they were not legally collected. No one ought to refuse to have the Treasury Department return the money that is illegally collected, no matter who the taxpayer is, whether it is the farmer or the small business man or the big business man from whom large taxes are collected.

*Washington (D. C.) Post*

*A Big Job With a Little Shovel*

I deplore beyond expression these statements that would lead to the belief that these refunds were mere gifts back to the taxpayer for an ulterior purpose."

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Speaking on the bill to establish a Federal farm board to aid in the orderly marketing and control and disposition of the surplus of agricultural commodities, **Senator Schall,** Minnesota, contended that this legislation marks an epoch in our agricultural-tariff development. He said:

"I believe in a reasonable or adequate tariff protection for labor and for those engaged in manufacture. I would not reduce the tariff on manufactured products to the point where it would fatally injure the economic structure which is today giving such wonderful prosperity to the people of the industrial and financial centers of our country. The vast farming sections should enjoy prosperity comparable to that now existing in the industrial and financial sections of the United States, and it can not do this unless some scheme can be put into effect which will give the farmers the benefit of the protective tariff that other industries now enjoy. It seems to me the McNary-Haugen plan will most nearly attain this end.

"The emergency tariff act of 1921 and the tariff act of 1922 both recognized the need and importance to the farmers of this country of protecting by tariff duties our farm products from the ruinous and ever-increasing importations from competing foreign countries. The act of 1922 may be called the first regular agricultural tariff act of this country, because of the increased importance given in that act to the duties on agricultural products.

"Domestic farm products that were threatened by importation of similar foreign farm products were given the protection then considered necessary to equalize the cost of production of the like or similar articles produced in the United States and in the principal competing foreign country. And under this act literally hundreds of domestic farm products are protected in this great home market of ours."

ANOTHER CUT OF THE SAME MEATER!
SORRY SIR! WE HAVE LOTS OF DOUGH BUT THE COOK IS ABOUT TO QUIT UNLESS WE GIVE HER A RAISE
CONGRESS
BIG TAX PAYER
U.S. TREASURY
22½% CUT

*The Rocky Mountain News*

*All Dressed Up, And a Year To Go*

Contending that this bill is founded on a vicious principle, that it is a mere palliative, and should it become a law would aggravate and intensify the very conditions it aims to alleviate, **Senator Gillett,** Massachusetts, said:

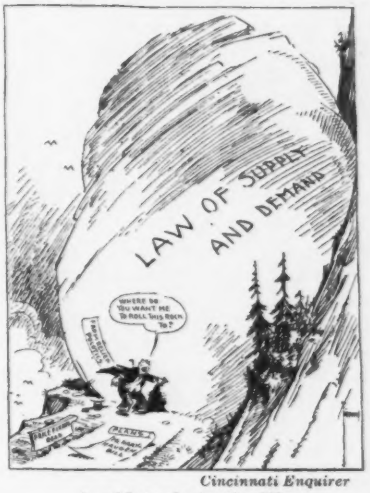
"The difficulty which is alleged to be at the root of the farmers' present sufferings is the surplus of production. The farmers are producing too much. That surplus has to be sold abroad in competition with producers who, because of cheaper labor and cheaper lands, can undersell us, and therefore the home price is by this competition reduced. If the surplus was small it probably would not produce that effect; but when, as in the case of wheat, we regularly grow a third more than we can consume, that enormous balance hangs over and depresses the market. Therefore the object to be accomplished, and what this bill aims at, is to prevent this surplus from reducing the value of the rest.

*Omaha World-Herald*

*It's a Great Life—and He Never Weakens!*

"Now, the normal method of getting rid of a surplus in all other branches of industry is to discourage production. That results automatically from the fall in price. When men find that an article gluts the market and so can not bring a fair it is useless to continue to produce what they can not sell at a profit, turn their activities to something which will be remunerative.

"In my section we have seen cycles of overproduction of manufactures, and when any manufacturer finds that the market is so overstocked that he can not dispose of his product, he does not come to the Government for assistance, but he shuts down his mill. Today in New England there are a large number of mills closed or running on short time because there is a surplus and they can not dispose of their products, and thousands of employes are out of work waiting for a time when the market will absorb the surplus and they can again produce and sell. They ask no aid from the Government when that surplus is manufactured in America. If, as is now asserted to be the case, a large part of it is manufactured abroad and because of the cheaper labor there can pay our tariff and still undersell American products, then they ask, and I believe ought to be granted, a tariff large enough to equalize this difference of labor costs. But when the competition is in the United States and the surplus is produced here, then they have no remedy except to stop production and wait until the surplus is absorbed. Why should not the same law of supply and demand govern every industry?




*Cincinnati Enquirer*

*An Obstacle in the Way*

"The argument which is made for this bill that it aims to render the tariff really protective as to the farmer's product is uterly unsound. A protective tariff is not intended to protect or affect a domestic surplus. All the tariff aims at is to insure the market against the entrance of foreign goods produced by cheaper labor. It applies to agriculture as well as to manufactures. Foreign agricultural products are kept out today by our tariff, but when the home supply exceeds the home consumption, no tariff can remedy the condition."

# NEWS OF THE MINING FIELD

*A Résumé Of The Activities Of The Mining Industry And Items Of Interest In The Field*

### Sinking Begun at New Phelps Dodge Shaft

The new shaft of the Phelps Dodge Corp., at Warren, Ariz., will be known as the Dowell Shaft. The shaft was sunk by hand to a depth of 35 feet, the collar concreted and a steel headframe erected. The headframe was moved from the Lowell Shaft.

Sinking of the shaft, which is under contract to the E. J. Longyear Co., of Minneapolis, has begun.

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### New Hoist Installation at Park Utah

The Park Utah Consolidated Mines Co., Keetley, Utah, has completed installation of a new automatic ore hoist. The new hoist, of foreign design and invention, is known as the Bollen Hoist. It was purchased through the Nordberg Manufacturing Co., which owns the right of manufacture and distribution in this country.

The chief advantage of the Bollen Hoist is adaptability where space is valuable. At the Park Utah, the hoist is installed underground and this advantage is, therefore, important. The hoist is installed directly above the shaft and only 16 feet above the collar. It is enclosed in a compartment 12x15x9 feet.

Operation of the hoist is automatic. It may be wholly automatic or it may be operated from the cage or from any level. The hoist has a capacity of 500 tons in six hours. Trip capacity is 4½ tons per trip. The rate of speed for the present operating depth of 400 feet is 400 feet per minute. At greater depth, the speed may be increased to 1,000 feet per minute.

The new hoist has been placed in operation and is proving entirely satisfactory.

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### Mercury Mine Will Be Reopened

O. D. Hassett, president of the International Mercury Corp., has announced that his company has taken an eight months' option on the property of the Mount Jackson Quicksilver Co., at Mount Jackson on the Russian River in Sonoma County, Calif. This old mercury mine began operations in 1875, but closed down in 1906 and has never been reopened since.

The International Corp. will install new machinery, including an 80-ton rotary furnace. Operations will begin as soon as equipment can be installed.

### A Discovery at Plymouth Mine Confirmed

Discovery of a 14-foot vein of excellent gold ore on the lower level of the Plymouth Mine, Plymouth, Calif., has been confirmed by the management. The ore is reported as averaging $30 per ton. The Plymouth Mine was taken over by the Argonaut Co., about two years ago, after the Plymouth Consolidated, controlled by British capital, suspended operations.

At the Argonaut Mine preparations are under way to sink the 5,240-foot incline shaft another 200 feet. This will make the Argonaut the deepest gold producer in North America. Repairs to the Muldoon shaft, maintained as an emergency exit, have been completed.

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### California Zinc Company Resumes Operation

Work was resumed on January 24, at the Bully Hill and Ingot Mines of the California Zinc Co., after a shutdown of one week.

The company suspended operations and laid off its force of 220 men without announcing any reason therefor, and it was assumed that the shutdown would be for an extended period. The 220 men who were laid off will return to their old jobs.

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### United Verde Extension Begins Work at Bisbee

Construction of a power line, which will furnish power for development of the Bisbee Queen group, recently taken over by the United Verde Extension Mining Co., is under way. A 2,000-foot line will connect with the main power line of the Phelps Dodge Corp., on the Bisbee-Douglas highway.

M. J. Elsing, consulting engineer and geologist of Bisbee, is superintendent.

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### Plant Ordered for Red Lake

A mining plant has been ordered and shipped for the Howey Gold Mines property at Red Lake, Ont., Can., along with large quantities of supplies. The plant is a six-drill outfit capable of development to 1,000 feet. It is hoped to have the mine opened up to a depth of 500 feet by next fall, when an idea of milling requirements can be had. Permanent buildings are being put up to replace the present temporary structures.

### Western Apex Development

The Western Apex Mining Co., at Oatman, Ariz., is believed to be at a big development stage, according to a report just made by W. K. Ridenour, the company's president, to officials at San Francisco. The cross-cut on the 850-foot level from the No. 3 shaft of the United Eastern is now out 400 feet from the shaft, and it is expected that the extension of the ore body from the 700-foot level of the Western Apex will be encountered. Stringers of ore are already making their appearance in the face.

Since $11,000,000 was taken from the United Eastern, and the orebody in the present workings is believed to be a continuation of the 700-foot orebody in the United Eastern, the work is being watched with much interest. The orebody has been developed for 1,275 feet in the Western Apex ground. A raise is being made in the east end of the property from the 700-foot level, at a point near where it is expected that the cross cut from the 850-foot level will cut the ore.

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### Campbell Ore Body Develops

Continued development work in the Campbell ore body of the Calumet & Arizona shows a steady improvement in mineralization and tonnage, and proves the work of the company on the strike so sensationally reported a few months ago to be very satisfying, according to reports of company officials made in Boston. Although the possibilities of the new discovery are enormous, officials say the tonnage this year will measure up no more than 1,000,000 tons of ore in the ore body. Some of the ore runs 25 to 30 percent copper, though much of it is 3 percent to 4 percent, and the average minable ore will be about 7 percent, in itself a high grade product.

The cross cut on the 2,200-foot level from the Junction Shaft on the Campbell workings is about 700 feet from the Campbell shaft. If ore is found at the level it will add very much to the prospects. Action by other operators, including the Phelps-Dodge Corp., indicate a belief that the area is a rich one and may produce many millions, depending on the stabilizing of copper at a reasonable selling price to justify the possible extension. The Phelps Dodge Corp. has decided to sink a shaft 2,000 feet deep, approximately 2,000 feet to the east of the Campbell shaft, and in virgin ground.

### Begin Work on Lead Smelter at Douglas

The first work in connection with the construction of the new lead smelter at Douglas, Ariz., was begun January 27 when a force of men was put to work tearing out machinery in the old plant at the Copper Queen smelter, which will be occupied by the new lead plant. Phelps Dodge officials announce that construction of the lead smelter will be carried forward as rapidly as the old units can be removed.

### Snyder Group Takes Over Colorado Property

Negotiations have been closed whereby William F. Snyder and Sons, of Salt Lake City, will take over the properties of D. R. C. Brown at Aspen, Colo. These properties aggregate about 730 acres, which is approximately half of the producing area at Aspen. J. C. Jensen is associated with the Snyders.

The properties included in the deal, through purchase on long time lease, are the McVeagh, the Dawn Lode, the Smuggler Mountain Tunnel, the Della S., the Bushwacker-Alpine, the Realization, the New Homestead and the Alta.

### Mercury Furnace Installed

A 60-ton Gould furnace is being installed by the Arizona Quicksilver Corp., at its property north of Roosevelt, Ariz. The work is in charge of Eric Freitag, manager, and H. W. Gould, consulting Engineer, of San Francisco.

### Verde Extension Enters Tri-State District

The United Verde Extension Mining Co., Jerome, Ariz., has purchased a half interest in the Jasper Mining Co., near Joplin, Mo. A new mill with a daily capacity of 600 tons is to be built this year.

The officers of the Jasper Mining Co., are: R. M. Atwater, president; Charles F. Dike, general manager; and L. E. Wicher, treasurer.

### Tri-State Association Committees

The directors of the Tri-State Zinc and Lead Ore Producers' Assn., have selected the following committees:

Executive Committee—J. F. Robinson, C. F. Dike, S. H. Davis, T. F. Cayne, Frank Childress.

Finance Committee—F. H. Kissling, H. W. Harrison, W. T. Landrum, P. B. Butler and George O. Pearson.

Membership Committee—M. F. Owens, George Provine, O. W. Bilharz, Charles A. Neal and C. Y. Semple.

J. D. Conover was reselected secretary of the association.

### Tri-State Mills Close

News from the Tri-State Zinc and Lead District is to the effect that lower prices for ores has recently closed a number of mines in that field. Mines No. 6 and No. 8 of the Consolidated Lead & Zinc Co. were closed most recently for an indefinite period, and only four of its 13 mines in operation. Still other companies are contemplating the closing of their operations until prices of ore are improved.

Among the mines closed during the last few weeks are the Rialto, the Velie-Lion, The New Chicago No. 1, The Domanda, the Jack and Jill, the Fox Mine, and mines of the Century Zinc, Vinegar Hill and Smith David group, mines of the Skelton Lead & Zinc Co., the Lucky Syndicate and three others of the Federal Mining & Smelting Co., five mines of the Eagle-Picher Lead Co., the mine of the Howe Mining Co., and the Bilharz and Early Bird Mines of the Tri-State Mining Co., as well as the Bonnie C. and Just Right Mines.

Some of the mines may reopen within a short time, according to announcements, but others likely will remain closed for many months.

The prevailing low prices of zinc and copper also has caused the closing of the Afterthought Mine, Atsingot, and the Bully Hills Mine and flotation plant at Winthrop, by the owners, the California Zinc Co. The closing of the California mines, near Redding, has thrown out of employment approximately 225 men, according to news from Redding. No indication has been given as to whether the closing is to be for a short time or of long duration. The mines have been producing zinc concentrates for Belgian consumption and the copper output has been shipped to Tacoma.

International Newsreel

*An Interesting Photograph Showing Primitive Means Used for Transporting Manganese Ore in the Caucasus*

### New Superintendent for Butler Bros.

R. O. Hocking, of Hibbing, Minn., has been appointed general superintendent of mining operations of Butler Bros., effective March 1, with headquarters at Nashwauk, on the Mesabi iron range. Mr. Hocking was formerly superintendent of inspection for Meriden Iron Co.

A crushing plant to crush and prepare trap rock is being built near Ft. William, Ont., by the Quinn Stone & Ore Co., Ltd., a Canadian corporation. The construction work is expected to be completed by May 1.

### Big Demand for Oil Anticipated

The domestic oil industry will be called upon to supply during 1927, a total of 346,520,000 barrels of gasoline, if the usual 16 percent ratio of increase in annual consumption is maintained during the current year. The gain in 1926 over 1925 was 16.9 percent. The total consumption in 1926 was 298,724,000 barrels, or 47,796,000 barrels less than the estimated demand for 1927. The 1926 increase in demand over 1925 was 43,362,000 barrels.

The average monthly export and domestic demand for 1927, as estimated will be about 28,900,000 barrels, or nearly 1,000,000 a day, whereas the daily consumption in 1926 averaged 817,334 barrels. The demand in January, 1927 was 20 percent above the demand for January, 1926, due largely to the unusual nature of the January weather throughout the country.

## NEW SHIPPING CENTER FOR MERCURY

Tacoma, Wash., became the connecting link between the International Market at New York and the mercury mines at Morton (61 miles from Tacoma) as the point believed destined to become one of the mercury centers of the world, by loading here the first shipment of the elusive liquid metal to the Atlantic Coast.

On Saturday, January 15, a shipment of seventy iron flasks, each containing seventy-five pounds of mercury, was received at the port piers and was loaded on the Willfare, of the Williams Line, for New York.

The mercury in each flask is worth $96.90, making the value of the entire shipment worth $6,783, or $1.27 per pound.

Although this is the first shipment from the Morton mines it is expected to be the beginning of a continuous mercury traffic between Tacoma and New York.

### "High-grading" California Ores

As a result of activity by the California Metal and Mineral Producers Assn., in cooperation with the California State Mineralogist in an attempt to curb the practice of "high-grading" California ores, the introduction of a bill to provide for Federal control of the situation is likely in 1927, when the next regular session of Congress convenes. The enforcement of state legislation has had the effect of forcing the high-graders to send or take their stolen gold to mints and assay offices of the Government in states adjoining California.

Since these states have no cooperative legislation, the need for Federal legislation became apparent to the California operators, who, through the association, conferred with Director Grant, of the United States mint, and received his offer of support and cooperation.

Senator Shortridge, of California, is known to favor such Federal legislation, but suggested to the California mining men that its introduction be delayed until the regular session of Congress which will convene in December, 1927.

A draft of a proposed bill to provide for Federal authority in combatting the "high-graders" has been considered by the California association, and is as follows:

"Whoever, with intent to sell or otherwise dispose of the same to the United States, shall bring or send, or cause to be brought or sent, or shall willingly assist in bringing or sending, any stolen gold, silver, or other metals, knowing said gold, silver, or other metals to have been stolen, to the Treasury Department, or any United States Mint or United States Assay Office, or whoever, with intent to defraud, shall deceive or impose upon, or shall attempt to deceive or impose upon, any officer or employe of the Treasury Department, the United States Mint or the United States Assay Offices, as to the source from which gold, silver, or other metals, offered for sale or disposal to the Treasury Department, United States Mints, and United States Assay Offices, was received shall be fined not more than $5,000, or imprisoned for not more than ten years, or both.

"The Secretary of the Treasury is hereby authorized to direct and use the Secret Service Division of the Treasury Department to detect, arrest, and deliver into the custody of the United States Marshal having jurisdiction, any person or persons violating any of the provisions of this Act."

As a result of the investigative work done in California, in cooperation with the State Mineralogist, during 1926, six persons were sentenced to State's Prison, and five indictments were pending in Federal courts, at the close of the year, and four other convictions under misdemeanor charges had been obtained, while many other cases were under investigation. The total value in ores recovered, or held pending investigation or court action, was more than $4,800.

An additional sum of $6,650 was being held in custody of the United States mint, pending the result of a suit instituted by the California association, through its secretary-treasurer as assignee of the mines involved, to recover values disposed of by one man, who confessed that he had purchased the ore from miners employed in the Kennedy, Argonaut and Central Eureka mines in Amador County.

This agent has been tried and convicted in the U. S. district court at Carson City, Nev., on a charge of using mails to defraud by the shipment of stolen bullion from Tonopah, Nev., to the U. S. Mint at San Francisco, the ore that he confessed had come from California mines.

### New Mine Started in Old Field

The Haddock Mining Co., of Wilkes-Barre, in February, began work on a new mine at Salem Hill, otherwise McCann's Hill, between Pottsville and Port Carbon. It will be known as the Salem Hill colliery.

The first step in the program, which will take about a year to complete, is driving a tunnel to the north about where the south slope of the hill adjoins the state highway between Pottsville and Tamaqua. The tunnel will be about 1,200 feet long, and it is possible that development of the beds cut will be started long before the tunnel gets to its limit.

A bore hole is being sunk on the east bank of the Schuylkill to test the measures, and it is possible that a shaft will be sunk there. It is planned to sink a slope at the north end of the tunnel and if the shaft is decided on there may be a second tunnel driven to connect the slope and the shaft. The plans include a breaker with a daily capacity of 800 tons.

There have been many stories circulated in the region based on this new development, most of them bearing a good deal of embroidery in the way of tonnage calculations and giving the impression that a hitherto untouched field of anthracite is about to be developed. Mining men of course know that the Schuylkill Valley was one of the earliest anthracite territories worked.

At least one hundred years ago George Shoemaker, who had carted coal to Philadelphia in 1812 from Necho Allen's property on the Norwegian, offered for sale a coal property a little north of the present Port Carbon, and mentioned that it had been developed by drifts. The Schuylkill Canal was extended to Port Carbon ninety-eight years ago to care for the tonnage being produced in the Schuylkill Valley. There have been periods when considerably more than fifty mines were working simultaneously in the stretch between Pottsville and Tamaqua, though it is

true that today there are less than a dozen.

Those early developments, it is true, were very largely scratchings, being either water level mines or workings below water level which were very limited in their scope. The real significance in the Haddock Mining Co.'s plans is that another group of real mining men has come back into the old Schuylkill Valley field and by the application of modern methods will develop every workable bed on the tract. Although there is no doubt a great quantity of coal in the Schuylkill Valley, that territory presents mining problems of its own which apparently proved too difficult for past generation.—(*Anthracite Bureau of Information.*)

### Ask Views on Mine Law Change

With a view to the desirability of asking the state legislature to amend the laws of Utah with reference to the location of mining claims, A. G. Mackenzie, secretary of the Utah Chapter of the American Mining Congress recently sent to members of his organization, a questionnaire asking for an expression of their attitude. The letter accompanying the questionnaire was as follows:

"It has been suggested that an effort be made at the present session of the state legislature to have the Utah state laws, with reference to discovery and location of lode and placer claims, amended along the following general lines:

"1. To require placing of monuments or stakes within 30 days after discovery; recording of claim within 90 days from date of discovery.

"2. To require location work equivalent to 4 ft. by 6 ft. by 10 ft., or 240 cubic feet of excavation at the point of discovery to be completed within 90 days after date of discovery.

"3. To require stakes to be set at middle of side lines instead of middle of end lines as at present.

"I understand that Utah and California are the only two western states that do not now have requirements similar to these. It is suggested that under our present procedure a person can tie up mineral ground for two years without properly doing any work whatever, and this condition has led to abuses."

### Indiana Would Re-Enact Old Mining Law

A measure recently introduced in the Indiana House of Representatives would re-enact a section of the 1917 mining law requiring the closing of airways in unused parts of coal mines. The 1917 law was repealed in 1923 when the codified mining law was passed. The purpose of the measure is to force air circulation in parts of mines being worked and to improve the general ventilation of mines. Such airways, or breakthroughs, would have to be placed between rooms or entries at intervals of 45 feet or less. Under the 1923 law, the author of the present bill claims, it is possible for airways to be left open in closed parts of the mine, thus impairing the circulation in parts being worked.

## MACKENZIE OPPOSED SPIEGEL BILL

EMPHATIC points were brought out by A. G. Mackenzie, secretary of the Utah Chapter of The American Mining Congress, in a recent address before the State Association of Clerks, Auditors, Treasurers and Assessors of the state of Utah, at Salt Lake City, opposing the Spiegel bill, proposing an increase in the state tax on mines. Some of Mr. Mackenzie's outstanding statements were:

When there is nation-wide demand for relief from heavy taxes, it is disconcerting to meet a proposal for a two-thirds increase.

Investment of outside capital in Utah should be encouraged, not discouraged. Development is important to all elements.

Large mining operations encourage smaller mining concerns to persevere in making their properties profitable.

Non-resident interest in Utah mines exists to the extent that Utah people have failed to invest, but non-resident interest in the Utah enterprises is not confined to mines.

Returns from mines do not represent income only, but the return of capital invested.

The metal mines of Utah face a problem which, if not properly met, will have economic effects upon the state of a disastrous nature.

The metal mines now are probably more fully and exactly assessed than any other property in the state.

Tax discussions usually bring out assertions that one or another sort of property is not bearing its proper burden.

Many persons merely consider mine dividends and ignore more important facts of the industry.

The metal mining industry employed 12,411 men, whose wages aggregated $20,658,234, in the year ending June 30, 1926.

Populous communities depend entirely upon the metal mining industry.

### More Litigation in Federal Case

The adverse decision rendered by the Delaware Supreme Court in the case of H. Content & Co., against the Federal Mining & Smelting Co., early in February, will not close the proceedings, according to F. H. Brownell, president of the Federal Co. Commenting on the opinion Mr. Brownell reviewed the action and made the following statement:

"The Supreme Court of Delaware held: 'Under the charter contract existing between the defendant company and the complainants as preferred stockholders, of which contract pertinent statute law forms a part, dividends can not be paid on the common stock when the capital of the company is greatly depleted and its net assets are less than its paid-in capital. This is the sole question to be determined by this court.'

"This decision was rendered on a demurrer to a bill of complaint which alleged that the company's net assets were not equal to the paid-in value of its capital stock. The company has carried its properties largely in accordance with the system used by the Treasury Department. Under this system, adequate expression is not given to the value of increased ore deposits ascertained to exist, and to property values in excess of original cost. The balance sheet of the company, therefore, has indicated a deficit of net assets below paid-in capital. The court having held against the company on demurrer, answer will now be made and evidence will be taken on the question of fact whether the net assets exceed the paid-in value of the capital stock.

"As indicated in the last annual report and the circular to stockholders issued early in 1926, the true valuation of the company's properties will considerably exceed that reflected by the books of the company. Careful study has been made of the property values, which will be discussed in the coming annual report. The officers of the company believe that the court will ultimately find such existing value of the company's assets as will permit the payment not only of dividends on the preferred, but on the common, at least to some extent and for some period of time.

"If the evidence fails to disclose an excess of net assets over paid-in capital stock, the right to pay dividends on the preferred stock would, under the reasoning of the court, become doubtful. Considerable litigation is therefore still in prospect, and the final answer to the two questions above outlined will not be known until its termination."

### Enjoined From Emptying Mine Drainage Into Cold Stream

Atherton & Barnes, Philipsburg, Pa., coal operators, were permanently enjoined for emptying mine drainage into Cold Stream, near Philipsburg, in a decree filed in the Centre County Court by Judge Harry Keller, on January 18. The case originated in 1917 when the company was enjoined from emptying drainage into the stream. The latter action was pressed by the Penn Public Service Corporation, the bill of complaint setting forth that the drainage was causing heavy damage to boilers at its power house which was drawing water from the stream.

### Anthracite Coal Bills

Much of the interest in legislation by the Pennsylvania legislature now in session is in the many bills introduced, dealing with the coal industry, particularly those relating to anthracite. Much attention has been given to the reorganization of the Department of Mines, promised by Governor Fisher in his inaugural address, but nothing as to its nature has been announced.

### Bill Would Compel Purchase Ohio Coal

Legislation already approved by the Senate and probably will be adopted by the House of the Ohio General Assembly will compel all Ohio state institutions to buy coal mined in Ohio, and no other. The bill was sponsored by Senator E. Lafever, of Athens County, and received a unanimous vote in the Ohio state senate. Governor Donahey, it is reported, has indicated that he will approve the measure if passed.

### Union Activities Do Not Alarm West Virginia

Coal operators in southern West Virginia and northern West Virginia are not alarmed at reports recently circulated in the southern field by delegates returned from the United Mine Workers' Convention at Indianapolis to the effect that the union will soon launch a vigorous organization campaign in southern West Virginia. An organization campaign has been quietly under way for several months in the southern part of the state it is reported, and union men say the campaign can be made much more vigorous if necessary. Claims to the effect that the miners in the non-union mines are joining the union, but are continuing to work in open-shop mines until called out apply to a very few men in the view of the operators.

No organized plan to combat the reported campaign of organization has been made by the operators, who believe the failure of earlier efforts to organize southern West Virginia indicate the impossibility of working up a lot of encouragement among the miners employed by non-union mines. The difficulty union organizers would meet in running counter to state and federal injunctions now in effect are another reason the operators are not fearful.

## NO 1927 COAL CONTROL

**PROPOSED legislation for the regulation of the coal industry was definitely shelved by Congress when the House Committee on Interstate and Foreign Commerce decided by a vote of 12 to 7, on February 9, that no further coal control bills would be considered before adjournment. This action by the committee disposed of the most recent effort of Representative Parker of New York, to regulate the industry during emergencies, through Governmental control, as his bill, introduced on Februay 5, provided. The bill was styled "The Emergency Fuel Act of 1927."**

### Coal Development in Kentucky

Plans for an extensive development on coal, clay and iron ore properties in Lawrence County, Ky., to begin within 60 days, have been announced by the Kentucky Mining & Navigation Co., with capitalization of $2,000,000. The property lies between Louisa, on the Big Sandy River, and Webbsville, the rail head of the Eastern Kentucky Railway. Operation of a barge line on the Big Sandy, with a river terminal at Louisa, or below is contemplated, and a rail line will be constructed from the river to the mines. Properties to be developed include 12,000 acres. The company's personnel is as follows:

R. E. McQuay, of New York, president; H. W. Johnson, of Georgia, secretary-treasurer, and the following additional members of the board: Dr. Henry Mace Payne, consulting engineer, American Mining Congress, Washington; W. A. Kitchen, of Ashland, and J. Johnson, of Tennessee.

### Glen-Alden Elects Officers

The Glen-Alden Coal Co., Scranton, Pa., held its annual meeting early in February, re-electing the following officers: William W. Inglis, president; S. D. Dimmick, vice-president and general manager; George N. England, secretary and treasurer; J. L. Dodson, assistant secretary and assistant treasurer. Other members of the board: John H. Brooks, Frank H. Hemelright, J. Hayden Oliver and Frederick J. Platt.

### Coal Lease

A lease to develop coal on 880 acres of public land in Wyoming will be awarded to the Altamont Coal Co., of Evanston, Wyo., in the absence of adverse claim, according to announcement by the Interior Department.

The company has a preference right claim to a lease on the area, which is located in Uinta County. Provisions of the lease stipulate that the company must make an initial investment of $45,000 during the first three years in developing the property and must produce a minimum of 35,000 tons of coal per year commencing with the fourth year of the lease. A royalty of 12½ cents per ton, mine run, on all coal produced must be paid the Government.

Sale by public auction of coal leases on two other tracts of public land located in Utah and North Dakota was also authorized by the Department. The first tract comprising 111 acres is situated in Emery County, Utah, and the lease will be offered by the local land office at Salt Lake City, the date to be announced by that office later. Under its terms the successful bidder must pay the Government a royalty of 15 cents per ton on coal produced, must make an initial investment of $500 during the first three years and must produce at least 300 tons of coal per year commencing with the fourth year of the lease.

The second tract contains 40 acres and is located in Mountrail County, N. Dak. The auction sale will be conducted by the local land office at Bismarck, N. Dak., the exact date to be made public later. The successful bidder obtaining the lease must make an initial investment of $500 during the first three years and must produce a minimum of 400 tons of coal per year beginning with the fourth year of the lease. A royalty of 10 cents per ton, mine run, must be paid the Government on all coal produced.

### Purchases Coal Property

The property of the Summit Coal Co., at Summit, Walker County, Ala., has been purchased by the Alta Coal Co., a subsidiary of the Southern Cotton Oil Co., of New Orleans. R. T. Daniel, of Birmingham, who has been operating the Summit coal properties as receiver will act as general agent for the new owners. The Summit operations are a slope opening on the Black Creek seam.

### Extensive Stripping Operations Planned

Extensive stripping operations will soon be opened on 410 acres of coal and clay land northeast of Carbon, Ill., by the Sherwood Coal Co., which recently closed options of the property under development.

### T. C. & I. Improvements

The Tennessee Coal, Iron & Railroad Co. has recently completed extensive improvements at its No. 8 Mine, near its Fairfield works, Birmingham, Ala., which will facilitate the handling of the output and enable a largely increased production. Conveyor belts have been installed in the mine for the main haulage and other modern equipment has been installed both inside and out to thoroughly modernize the plant and speed up production.

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### Alabama Ends Convict Leasing

After a long wrangle the Alabama legislature has finally passed the law which ends the leasing of convicts for work in coal mines, providing for the removal of all prisoners from the collieries by July 1, 1928. County convicts will all be placed on highway construction and are to quit the mines by July 1 of this year. There are approximately 1,500 convicts working in the coal mines of Alabama, and they will be gradually withdrawn.

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### Hudson to Drill New Shaft

Preparations are being made by the Hudson Coal Co. to start drilling some time in March on a new shaft in the Schuykill coal fields, where it has large reserves of coal. Surveyors and drillers, who have been working in the district for two years, are said to have found a thick seam of anthracite at the 700-foot level.

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Seven pumps, with a capacity of more than 6,000 gallons per minute, were used by the Connellsville By-Product Co. early in February to fill the burning section of their No. 1 mine in the Scott's Run field, W. Va. Fire started there on January 28, and there were several explosions as a result. In addition to the water being pumped into the mine, the waters of Guston Run have been diverted into the mine by gravity.

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A loss of between $55,000 and $60,000 was caused by a fire at the Summitt Coal Co. property, at Metalton, W. Va., recently. Six gathering motors, practically all supplies, a cutting machine, and a part of the blacksmith shop were completelly destroyed. It will be necessary to suspend operations for several weeks while repairs are being made.

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Fire of unknown origin destroyed the tipple of the Maple Run Coal Co., at Olanta, Pa., January 29, the loss being estimated at $90,000. The tipple was one of the most up-to-date in the central Pennsylvania field.

### Hudson Coal to Spend Large Sum in Development Work

Faith in the future of the hard coal industry is indicated by the Hudson Coal Co., in the announcement of plans from Philadelphia, to spend approximately $5,000,000 in development of properties in the Lewiston Valley, near Tamaqua. In addition to a large reservoir on which preliminary work has been started, the company will erect a $2,000,000 breaker of steel and concrete, and will establish a new mining town at the site. The reservoir will be similar to the Roosevelt Dam and will store 2,000,000,000 gallons of water. An eight-mile road along Wild Cat Mountain is being constructed for use in the construction of the reservoir, for which two years will be required. It is claimed that the new breaker will be the most modern in existence. The new work will provide employment for many men now idle in the Panther Creek Valley.

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### Electrification Project at Morea Colliery Completed

Installation of giant pumps in the Morea Colliery, with a 19,000-gallon capacity a minute, completes the huge electrification project which has been in progress for several years since Madeira, Hill & Co., took over the Morea and New Boston mines. At that time, the two collieries were made into one and most of the work of operation and preparation consolidated with headquarters at Frackville.

Electrification of the pumping plant has been preceded by installation of huge transformers, which will handle high-tension current supplied by the Pennsylvania Power and Light Co. The new plant is now in operation and is taking care of the drainage of both Morea and New Boston, the pumping plant at the latter colliery having been practically abandoned.

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### S. P. Hutchinson on Cruise

S. Pemberton Hutchinson, president of the Westmoreland Coal Co., Philadelphia, is taking a cruise of the West Indies. He sailed on the French liner LaFayette on February 5. Mr. Hutchinson is a member of the Board of Directors of The American Mining Congress, and a former president of the National Coal Association.

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M. J. Maloney, former traffic manager of the Central Iron & Coal Co., has been appointed general manager of the company in its operations in the Birmingham district, with headquarters at Holt, Ala. He succeeded the late James L. Brierton.

### Island Creek Increases Production

An increase of 97,000 tons over the production for January of 1926, was reported by the Island Creek Coal Co., for January, 1927, in which month 550,000 tons were mined. The 1926 production for January was 453,000 tons. December, 1926 production was 589,822 tons.

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### Cardiff Mine Reopens

The Clark Coal Co., has reopened the Cardiff mine at Tunnelton, W. Va., after an extended idleness. Employment is given to more than 100 men.

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### First Coal Shipment Made

The new No. 4 mine of the Kemmerer Coal Co., at Susie, Wyo., made its first coal shipment of four carloads late in January. The coal was hand-mined, but it is likely the mine eventually will be mechanized. It is expected to become the largest mine in the Kemmerer district.

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### Maxwell Mine Reopened

After an idleness of two years, the Maxwell mine of the H. C. Frick Coke Co., at La Belle, Fayette County, Pa., is to be reopened, work of cleaning up having been started. Although the coke ovens will not be fired, employment will be given at once to about 200 men.

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### Warriner Would Harness Lehigh River

Harnessing of the Lehigh River between White Haven and Easton, Pa., for the development of electric power has been proposed by Samuel D. Warriner, president of the Lehigh Coal & Navigation Co. There is a drop of 500 feet in the river between White Haven and Mauch Chunk, and 360 feet between Mauch Chunk and Easton. Mr. Warriner's plan provides for a series of power plants, one to be located at Long Run, opposite Packerton.

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### Stripping Contract Awarded

The Lehigh Valley Coal Co. has awarded to the Rhodes Construction Co., of Ashland, Pa., a project for stripping operations on the Buck Mountain seam outcrop east of the Continental Mine at Centralia. Two or three years will be required to complete the work. Coal will be prepared at the Centralia breaker. The Lehigh Valley Coal Co. also has awarded a contract for stripping work between Greenwood and Moosie, to the Diamond Excavation Co., which will begin work at once.

### Coal Washery Built

A coal washery is being built and picking tables installed by the Brookside-Pratt Mining Co., on recently acquired property near Brilliant, Marion County, Ala., where work is being done on the Black Creek seam. This company is planning an increase in production at its Warrior River operations in Walker County, by the opening of another drift mine. They have recently added to equipment an electric locomotive, and will hereafter use hydro-electric power, instead of locally generated current.

### Colorado Coal Production

Production of coal in Colorado in December, 1926, exceeded the production for the same month in 1925 by 68,452 tons, recording 1,318,108 tons in December, 1926. The total output for 1926 was 10,591,869 tons, compared with 10,440,387 tons in 1925. Production of lignite in Weld County was responsible for much of the increase in total production, 200,000 tons being produced in 1926, in excess of the 1925 total. An average of 11,690 men was employed in 1926 as compared with 12,138 in 1925, and average days worked per mine in 1926 was 166.2 as compared with 156.4 in 1925.

### Illinois Coal Output

Output of coal in Illinois in 1926 was higher than in 1925, according to the State Department of Mines and Minerals. The December, 1926 output was 8,454,777 tons, from 227 mines, employing 71,805 men an average of 20 days working. The total for November was 7,900,478 tons, from 219 mines, employing 69,273 men, an average of 19.6 days working. Production in December, 1926, was about 1,000,000 tons ahead of the same period in 1925. Franklin County led in the total for December production, with 18 mines producing 1,947,519 tons, working on an average of 23.5 days, employing 14,713 men. In Williamson County the December production was 1,084,111 tons, from 27 mines, working an average of 20.8 days and employing 8,854 men.

### Pennsylvania Coal Co.'s President Resigns

The resignation of C. S. Goldsborough from the presidency of the Pennsylvania Coal Co., Dunmore, Pa., has been announced, as has also his retirement as head of the Hillside Coal & Iron Co., both of which companies are subsidiaries of the Erie R. R. His resignation will not become effective until a successor is appointed. No definite announcement has been made as to the successor, though it has been indicated at the company's offices that Michael Gallagher, chairman of the board, may succeed Mr. Goldsborough.

### President of Hazard Exchange

Henry Pfening, Jr., general superintendent of the South-East Coal Co., Seco, Ky., and the newly elected president of the Hazard Coal Operators' Exchange, has been identified with his present connection since 1916, having oeen in the employ of the North-East Coal Co. at Paintsville, Ky., since 1907 as mechanical engineer and in other capacities. He is a graduate mechanical engineer, taking his degree at the Ohio State University.

In addition to his coal interests Mr. Pfening is identified with banking and real estate in Kentucky, where he is president of the Letcher State Bank at Whitesburg, and a director of the First National Bank at Fleming. He was born in Wellston, Ohio, on September 23, 1891.

### New Washery at Alabama Mine

A new washery, tipple and other structures have been placed in operation by the Black Diamond Coal Mining Co., at Johns, Ala., replacing the plant destroyed by fire several months ago. The washery is of 1,000 tons capacity and preparation equipment will be capable of taking care of the output from both the Johns and Adger mines.

### Arkansas Coal Mine to Reopen

The Eastern Coal & Mining Co., will shortly reopen its No. 2 mine, at Denning, Ark., and operate under the 1917 wage scale. The mine was closed in May, 1924. A new tipple and shaft casing were installed last year following a cave-in which destroyed the old tipple. Shakers were also added to the new tipple.

### Michael Gallagher Elected Chairman of Board

The election of Michael Gallagher as Chairman of the Board, and also as president of each of the following coal properties of the Erie Railroad, has been announced: The Pennsylvania Coal Co., The Hillside Coal & Iron Co., the New York, Susquehanna & Western Coal Co., The Northwestern Mining & Exchange Co., and the Blossburg Coal Co. All but the last two of these companies are anthracite companies. The Blossburg Co. is a bituminous company, not in operation.

### W. D. Tyler Elected Vice-President

By recent action of the Board of Directors of the Clinchfield Coal Corporation, W. D. Tyler has been elected to the newly-made office of vice-president in charge of real estate. Mr. Tyler has been identified with the company for 20 years or more, as land agent. His offices will remain in Danta, Va.

### New Strip Mine to be Developed

Options on 2,000 acres of stripping lands about five miles east of Petersburg, Ind., have been taken by the Patoka Coal Co., with plans for the opening of one of the largest stripping operations in the state early in the spring. The company is now drilling out the territory and is making surveys for a switch leading from the Big Four Railroad.

The Ingle Coal Co. also is taking options on stripping lands in the territory south of Petersburg.

### New Stripping Operation

Gray Brothers of Evansville, have acquired 1,200 acres of additional coal land in Pike County, Ind., at prices ranging from $80.00 to $100 an acre. About $100,000 has been expended in acquiring the property in Lockhart Township. Gray Brothers already own stripping lands valued at $500,000 in Pike County, and are operating two large shovels, and plan to put a third into operation on the James Bottom farm east of Arthur. It is not planned to begin stripping on the newly acquired lands at once.

### W. Va. Southern Coal Co.

Eleven southern West Virginia Coal companies, owning properties in Kanawa, Boone, Raleigh, Lincoln and Logan counties, have been acquired, and consolidated by the West Virginia Southern Coal Co., which has a working capital of $600,000, after paying for the properties, according to an announcement made recently in Huntington by Everett Drennan, of New York, president of the company. W. H. Cunningham, of Huntington, is vice-president and the company will maintain headquarters in Huntington, with offices in Charleston, and New York City, where Mr. Drennan's office will be at 44 Wall Street.

### Clinchfield Coal Corporation Will Enlarge Its Operations at Clinchco

The operations of the Clinchfield Coal Corp., at Clinchco, Dickinson County, Va., located 18 miles north of Dante, are to be enlarged and in connection with this program about 50 new houses will be built, increasing the number of houses at this operation to around the 300 figure.

J. M. Powell, formerly superintendent of the Warrior River Mine of the Brookside-Pratt Mining Co., Ala., has been made superintendent of the Turner Mine on the property of the New River Coal Co., recently acquired by the Brookside-Pratt Co. Ben Wright succeeded Mr. Powell as superintendent at the Warrior River Mine.

# COLORADO MINING ASSOCIATIONS MEET

Joint annual conventions of the Colorado Chapter of The American Mining Congress and the Colorado Metal Mining Fund were held in Denver, January 18 and 19, and brought together a large attendance of mining men from all districts for discussions of several economic and legislative problems of importance. Nine strong resolutions were adopted bearing on these problems.

Jesse F. McDonald, of Leadville, was re-elected president of the two organizations, which function with joint governing boards. M. B. Tomblin was re-elected secretary. Other officers re-elected were:

J. T. Barnett, vice-president; E. A. Colburn, second vice-president; R. M. Henderson, third vice-president; A. M. Collins, treasurer. The executive committee is composed of J. F. McDonald, C. M. Bell, R. H. Sayre, J. T. Barnett, J. H. Warner, A. B. Marquand, W. E. Renshaw, J. O. A. Carper, M. B. Tomblin.

A strong resolution against the proposed change in the Workmen's Compensation Insurance act, by the state legislature, was carried unanimously. The resolution pointed out that any increase in the compensation liability will place a burden on the industry that is just struggling to its feet in Colorado. It declared that no change should be made in the present law until a commission has had time to frame a scientific modification of some features that are now unjust to legitimate and careful operators.

Another resolution called for an appropriation by the Federal Government for the building of roads in the mining districts of the national forest reserves and a resolution was also passed against any attempt by the state legislature to reapportion the representation in house and senate on the basis of an old census made when the mining industry was at its lowest ebb.

The convention also went on record favoring the construction of the Dotsero cut-off to facilitate communication with the Leadville smelter for the mines in the northern part of the state. It also passed a resolution opposing the abandonment of the railroad service into the Clear Creek mining district. Another resolution recommended an amendment in the school lands bill now in Congress to permit the states to deal with mineral rights in ways similar to those under which mines are patented and located in the federal mining code.

The association went on record as opposed to any proposed extension of the national forest or to the creation of any new forest reserve. A resolution was also passed against the proposed extension of the Rocky Mountain National Park by the inclusion of a large tract of mineral land to the south of it. The association also declared its belief that cheaper railroad passenger rates would increase traffic to and from the mountain districts and urged the railroads of the state to consider the adoption of some such policy.

Among the speakers at the sessions were Dr. M. F. Coolbaugh, president of the Colorado School of Mines, who declared that the state has never given an adequate, regular support to the School of Mines, and urged the mining men to aid in impressing upon the legislature the need for cooperation with the school.

Senator W. E. Renshaw, of Idaho Springs, veteran mining man and legislator, brought to the meeting the assurance that the present session of the legislature will witness more hearty cooperation between the state and the miners than has been ever before realized.

An address was made by Fred Carroll, of Denver, expert on the shale industry, who reviewed the work done in the last year in the task of placing the shale oil industry on the map.

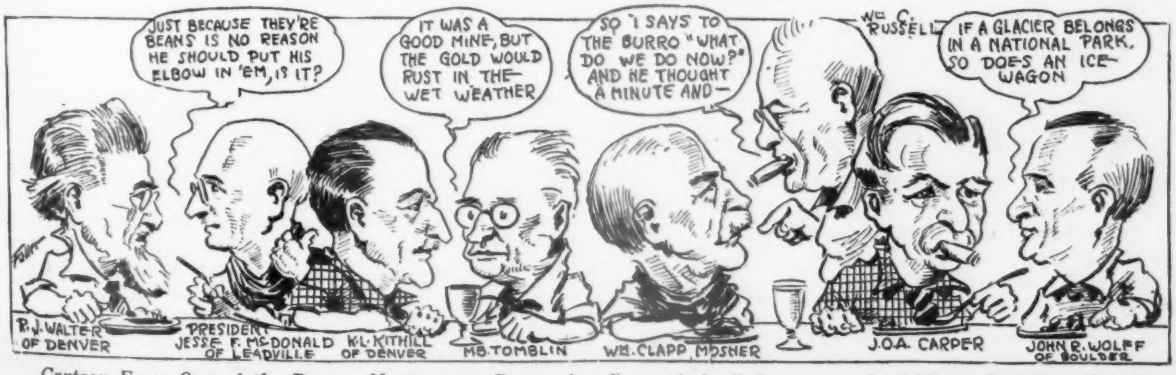
The use of diamond drills in exploration work in the Cripple Creek district was explained by A. F. Carper, son of J. O. A. Carper, of Denver, who is in charge of the prospecting work of the company handling the Stratton properties, headed by the senior Carper.

The scarcity of gold will be felt in an increased degree within the next ten years, George E. Collins, Denver mining engineer, told the convention in an address on the opening day. The world's supply is being depleted, according to Mr. Collins, and he predicted that a sweeping economic readjustment would be necessary. Although the relative scarcity of gold will be felt within the next ten years, its full effect will not culminate for many years, Mr. Carroll asserted.

The delegates were guests at an old-time mining camp "grub pile" of sow-belly and beans, served in rough camp style at the Albany Hotel, or "boarding house." The program at the spread included serious and facetious addresses, emphasizing present day differences in mining life and mining practices from those that prevailed years ago.

### Rocky Mt. Institute Holds Meeting

The 24th annual meeting of The Rocky Mountain Coal Mining Institute was held in Denver, February 23, 24 and 25. Among the speakers who took part in the meeting were: F. B. Thomas, chief electrician, Victor American Fuel Co.; W. D. Rockey, New Mexico Department of Education; H. A. Tiemann, of the U. S. Vocational Training Bureau; W. C. Holman, chief engineer, Phelphs Dodge Corp., Dawson, N. M.; P. H. Burnell, of the Owl Creek Coal Co.; H. J. Harrington, compensation manager, Union Pacific Coal Co.; L. C. Ilsley, U. S. Bureau of Mines; D. H. Harrington, U. S. Bureau of Mines; George B. Pride, chairman, Safety Committee, and G. R. Delamater, consulting engineer, Lakewood, Ohio.


JUST BECAUSE THEY'RE BEANS IS NO REASON HE SHOULD PUT HIS ELBOW IN 'EM, IS IT?
IT WAS A GOOD MINE, BUT THE GOLD WOULD RUST IN THE WET WEATHER
SO I SAYS TO THE BURRO "WHAT DO WE DO NOW?" AND HE THOUGHT A MINUTE AND—
W. C. RUSSELL
IF A GLACIER BELONGS IN A NATIONAL PARK, SO DOES AN ICE-WAGON
R. J. WALTER OF DENVER
PRESIDENT JESSE F. McDONALD OF LEADVILLE
K. L. KITHILL OF DENVER
M. B. TOMBLIN
WM. CLAPP MOSHER
J. O. A. CARPER
JOHN R. WOLFF OF BOULDER

*Cartoon From One of the Denver Newspapers Portraying Some of the Delegates at the "Albany Boarding House"*

# 135TH ANNUAL MEETING AMERICAN INSTITUTE OF M. & M. E.

***New York Meeting Outstanding Success, With Record Attendance—Excellent Program Arranged —Everette Lee De Golyer Elected President—Proposal Made To Increase Yearly Dues***

THE 135th Annual Meeting of the American Institute of Mining and Metallurgical Engineers was an unqualified success. Attendance was the largest of any annual meeting yet held, with approximately twelve hundred registrations. The program was an unusually interesting one, with papers upon every phase of the mining industry.

Everette Lee De Golyer, president of the Amerada Corporation, and its subsidiary, the Amerada Petroleum Corporation, was elected president. Mr. De Golyer is also president of the Geophysical Research Corporation and vice-president and manager of the Rycade Oil Corporation. He is a fellow of the Geological Society of America and a member of the American Association of Petroleum Geologists, and of the British Institution of Petroleum Technologists. He has contributed various papers concerning the Mexican oil fields, and the salt domes of the coastal region of the United States.

George Otis Smith, director of the United States Geological Survey, and F. Julius Fohs, consulting oil geologist, New York City, were elected director and vice-president. Other directors elected were as follows: Frank H. Crockard, J. O. Elton, Daniel C. Jackling, David Levinger and Richard Peters, Jr.

Samuel A. Taylor, the retiring president of the Institute, in his address at the business meeting, pointed out that the Institute must have more money to cover the field open to it, and suggested that the dues be increased from $15 to $20 a year. This matter was again brought up when the report of the treasurer was made, and when a special committee appointed at the January meeting made its report. Various members expressed their opinions both for and against such an increase, and apparently the matter will be considered and passed upon later. Mr. Taylor cited two outstanding events during the past year—first, the establishment and endowment of a gold medal to be awarded for "Achievement in Mining." This award was established by W. L. Saunders, past president of the Institute, and the first award was made to Mr. David W. Brunton, nationally known consulting engineer, of Denver, Colo. The February issue of THE MINING CONGRESS JOURNAL carries a full statement of Mr. Brunton's achievements. Unfortunately for all those concerned, Mr. Brunton was unable to be present at the meeting, being confined to Roosevelt Hospital, New York City, where he had just undergone a minor operation.

The second event referred to by Mr. Taylor was the gift of a library, comprising ten thousand volumes, which was made available to the Institute through the courtesy of the Anaconda Copper Mining Company, and Mrs. Horace V. Winchell, widow of the late Horace V. Winchell. The library was the property of Mr. Winchell.

Of great importance were addresses delivered to the convention. "The Growth of Crystals," by Cecil H. Desch, professor of metallurgy, Sheffield University, England, was delivered on February 16; Bradley Stoughton, head of the department of metallurgy, Lehigh University, Bethlehem, Pa., presented an address on "Alloy Steel," and Walter Barnum, president of the National Coal Association, spoke on "Problems of the Coal Industry." The address of Samuel A. Taylor, retiring president, was of special interest. Dr. E. L. Collis Talbot, professor of preventive medicine, University of Wales, addressed the Mine Ventilation session on "Physiological Effects of Mine Dust," and Robert G. Bosworth, of the Colorado Bar, discussed "The Duty of the Subsurface Owner."

A joint session of the Institute and the Mining and Metallurgical Society was held, at which "The Exhaustion of Mineral Resources" was discussed. The story of copper was told through the showing of a new moving picture film, as was "Building New York's Newest Subway." The Kennecot Copper Company and the E. I. du Pont Powder Company courteously loaned these films.

The first technical sessions were held on Monday, February 14. Problems of coal and coke were discussed, special emphasis being given to the effects of trends in gas manufacturer on the coal industry, evaluation of coal for by-product coke making, coal cleaning, management in mechanization, and factors in ignition of methane and coal dust by explosives. Mining methods were discussed at a luncheon at the Engineers Club, as was industrial relations, at a subscription dinner at the Mecca Temple Mosque.

Other sessions of the convention were devoted to "Mining Geology," "Mining and Milling," "Mine Ventilation" (both coal and metal), "Ground Movement and Subsidence," and special sessions devoted to iron and steel problems.

The Institute of Metals Division held three sessions, one devoted to zinc, another to copper, and a third to aluminum. The Petroleum Division arranged an unusually attractive symposium, discussing economics, refining, production, corrosion and several round-table discussions on petroleum engineering problems. This division also held a subscription dinner at the Engineers Club.

The Institute smoker was held on Monday evening, February 14, and was largely attended. It was a delightful entertainment, with music furnished by the Instrumental Club of Columbia University.

The annual reception and dinner was held at the Waldorf Astoria, in the grand ballroom. The president's reception was held at 7 p. m. The dinner was exceptionally well arranged and the program of sufficient length to make it interesting.

Special mention should be made concerning the entertainment under the auspices of the Women's Auxiliary, which planned a number of trips and special features for the visiting ladies. The Junior Committee also did yeoman service in making the convention's entertainment program a success.

Special trips and excursions were arranged, including trips to the Holland vehicular tunnels under the Hudson, a visit to a large plant manufacturing pumps and other kinds of mining equipment, to a New Jersey refinery, and other interesting places.

### Tri-State Mines Merge

The merging of four lead and zinc mines of the Tri-State district, forming the Interstate Lead & Zinc Company, with announced values totaling $4,000,000, has been reported by W. S. Connelly, manager of the Kansas City, Mo., offices of Tayler, Ewart & Co., of New York. R. M. Atwater, Jr., of New York, will be president of the new concern.

The companies merged are the Cherokee Lead & Zinc Co., the Oklahoma Woodchuck Mine Co., the Hutcheson Management Co., and the Meteor Lead & Zinc Co. The properties affected are in the southern Kansas and northern Oklahoma fields.

### Mining Institute Organized in Monongahela Field

The Monongahela Valley Coal Mining Institute, with 107 charter members, was organized at a meeting held in Morgantown this week, at which 160 mining men were present.

H. L. Meredith, chief engineer of the Connellsville By-Product Co., was elected president.

### N. E. Kentucky Assn. Holds Annual Meeting

The Northeast Kentucky Coal Association in its annual meeting held late in January at Ashland, Ky., electing the following officers:

President, H. LaViers, manager North-East Coal Co., Paintsville, Ky.; first vice-president, Lew Roach, manager, Elkhorn Piney Coal Mining Co., Powellton, W. Va.; second vice-president, T. T. Rogers, manager, Rogers Elkhorn Coal Co., Virgie, Ky.; treasurer, N. M. White, manager, Winchester Coal Co., Prestonburg, Ky.; secretary, C. J. Neekamp.

Executive Committee: C. H. Beidenmiller, manager, Glogora Coal Co., Huntington, W. Va.; John E. Buckingham, president, Wells-Elkhorn Coal Co., Ashland, Ky.; J. P. Burton, president, By-Products Coal Co., Cleveland, Ohio; F. G. Hatton, president, Hatton, Brown & Co., Columbus, Ohio; H. Preval, superintendent, Manufacturers Coal & Coke Co., Manco, Ky.; James P. Salisbury, president, Blue Beaver Elkhorn Fuel Co., Prestonsburg, Ky.; R. R. Smith, president, Elkhorn & Shelby Creek Coal Co., Huntington, W. Va.

### Monongahela Operators Hold Annual Meeting

Reelection of all officers and directors and a discussion of plans for a national advertising campaign for Monongahela coal, marked the annual meeting of the Monongahela Coal Operators' Assn., which was held in Morgantown, February 9. The association went on record in favor of a statistical program comprising past sales, sales realization reports and cost accounting.

John C. Brydon, of Baltimore, discussed the savings from group purchase of compensation and property insurance.

The report of Executive Secretary Pape contained reference to the services which the National Coal Assn. is rendering to the bituminous industry and also to the merit of the work which is being done by the West Virginia Coal Assn.

### Power Problems Discussed

Engineers from the staffs of the West Virginia Engineering Co., at Charleston, Williamson, Bluefield and Mullens, W. Va., and the coal fields of Kentucky and Virginia, served by the Norton Virginia offices, read technical papers on the power problems of the coal mining industry, at a recent meeting of consulting engineers. The discussions were attended by the following: H. P. Musser, J. P. Lively and T. K. Barnes, of Charleston; O. G. Crow, T. L. Elean, of Mullens; W. B. John, of Welch; W. W. Gilliam, Carl Duty, John Freese, A. A. Winter, F. D. Jackson and Miss Margaret Mays, of Williamson; C. H. Elson, of Brucefield, and Major G. C. Thornton, of Norton, Va.

## WINDING GULF DISTRICT PROSPERS

"THE Winding Gulf District functioned at full speed during the year 1926," asserts C. H. Mead, secretary of the Winding Gulf Association.

"The production of eleven million tons of coal in this district for 1926 places the district ahead of 1925 by approximately two million tons, and 1926 thus passes into history as the greatest coal production year the field has ever had. The demand for coal from this district for the year 1926 has been good with the exception of short intervals, and the prices have been such as to enable the majority of the mines to show a fairly profitable year.

"The market for smokeless coal has expanded until it is international. It is in demand in practically every coal consuming state in the union, in Canada and in several foreign countries.

"The labor conditions in the Winding Gulf district are exceptional and it is one of the few fields of the country that enjoys equal freedom from disturbing influences and labor disputes. The district commenced mining coal in 1907 and it has never had any serious labor difficulties. When the great strikes of 1919 and 1922 were called by the United States Mine Workers of America our miners continued steadily at work and produced a large tonnage of coal."

### Idaho Ass'n Holds Annual Meeting

With the general motif: "It's Time to Quit Kicking Our Mines Around!" the Idaho Mining Association held its twelfth annual convention in Boise, February 11 and 12, 1927, for a discussion of the important economic and legislative problems of the industry of that state. "Blue Sky" legislation and the need of a Foster station of the Bureau of Mines at Moscow, were topics on the program. Prof. Ernest W. Ellis led the discussion as to the need for the Foster station. Views illustrating the mining industry of the state were shown by Walter C. Clark, electrical engineer of the Bunker Hill & Sullivan.

In connection with discussion on the value of the industry to the state of Idaho, the association has distributed a folder, containing information as to the total of expenditures by non-producing development mining companies; producing companies not paying dividends; and in assessment work on mining claims and new locations on mining claims. Comparisons for 1924 and 1925 are given, showing that for 1925 such expenditures totaled $8,683,550, and in 1924 $6,267,908. In 1924 there were 2,064 men employed and in 1925 2,977. The items of expenditure recorded were for labor, supplies, mine and mill equipment and ore transportation. No figures were given in detail for assessment work expenditures, and such expenditures were not included in the totals.

Officers elected for the ensuing year were: Fred'k Burbridge, general manager of the Federal Mining & Smelting Co., Wallace, president; J. B. Eldridge, Boise, vice-president; Ravenel Macbeth, Mackay, secretary-treasurer. Mr. Macbeth enters on his fifteenth year of service as secretary-treasurer of the association.

In addition to the officers named, other members of the Executive Board were named as follows: I. E. Rockwell, Bellevue; Frank E. Johnesse, Boise; C. E. Nighman, Conda; Robert N. Bell, Boise; S. T. Davis, Boise, and Jerome J. Day, Moscow.

### Annual Meeting Hazard Coal Operators

The Hazard Coal Operators' Assn. at its recent annual meeting held in Lexington, Ky., elected the following officers: Henry Pfening, Jr., of Seco, Ky., president; W. W. Miller, Cincinnati, Ohio, vice-president; J. E. Johnson, Lexington, re-elected secretary, and Harry E. Bullock, Lexington, re-elected treasurer. The association announced an annual scholarship of $1,000 for worthy students in the Department of Mines, University of Kentucky. Presentation of the fund was made by Frank D. Rash, president of the Kentucky Mine Owners' Assn., and was accepted on behalf of the university by F. Paul Anderson, dean of the College of Engineering. Professor Norwood, of the University, was eulogized in Mr. Rash's address.

Class I railroads in 1926 had a net railway operating income of $1,231,494,000 which was a return of 5.13 percent on their property investment, according to reports just filed by the carriers with the Bureau of Railway Economics. Their net railway operating income in 1925 was $1,138,696,000 or 4.85 percent on their property investment.

A recent announcement by the Colorado Fuel & Iron Co., says that effective February 1, 1927, Mr. C. H. Murphey, assistant manager of sales, steel division, is appointed assistant to the Executive Vice-President.

### Joseph J. Walsh, Former Secretary of Mines, Now Mine Inspector

Joseph J. Walsh, of Wilkes-Barre, Secretary of Mines during the administration of Governor Gifford Pinchot, resigned to his chief on the last day of the administration, and Governor John S. Fisher appointed him as an anthracite mine inspector, assigning him to supervise the work of the department, pending its reorganization and the selection of a secretary of mines.

The appointment of the secretary as an inspector, a position he held for years prior to his promotion by Governor Pinchot, it is understood was the result of an understanding between the former governor and Governor Fisher.

Frank J. Hall, of Harrisburg, Deputy secretary of the department, is in reality acting secretary of mines, for he has been designated by the governor to sign all communications requiring the secretary's signature.

The reorganization of the department, along the lines suggested by Governor Fisher in his inaugural address, with a bureau for anthracite and one for bituminous coal supervision, can not come until the necessary legislation is prepared, presented to the legislature, passed and approved. The bill is being prepared at the present time.

Walsh was named to succeed Michael J. Brennan, an inspector, who recently resigned.

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### Phases of the Lignite Problem

Several methods of approach to the problem of the successful utilization of lignite are possible, states the Bureau of Mines. Any process whereby lignite can be profitably converted into more valuable and salable products will help to develop this latent source of energy. Accordingly an investigator might well study any of the following phases of the lignite problem:

A cheap means for completely gasifying lignite, including an improved method of making producer gas and a suitable method for making water gas.

A means for producing a solid fuel other than by briquetting the carbonized lignite.

The possibility of developing a means of coking lignite.

The commercial applicability of the carbonizing and briquetting process and its relation to by-products and methods for plant control.

A method for producing valuable crude liquid products by the distillation of lignite, with attention to the influence of changes in conditions, such as pressure, temperature, and rate of heating, on the character, quantity, and quality of the resulting products.

The possibility of hydrogenating or otherwise preparing liquid or soluble products direct from lignite.

Each of these studies offers a promising field, but only the carbonizing and briquetting process holds positive assurance that the experiments will end with a satisfactory solid domestic fuel. Some of these problems when solved would be more or less of local interest and not generally applicable to the large lignite deposits in different parts of the United States.

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### Graham Bright Goes to Mine Safety Appliances Co.

The Mine Safety Appliances Co., of Fittsburgh, Pa., announces the appointment of Graham Bright as sales engineer in charge of their Edison storage battery mine lamp division.

*Graham Bright*

Mr. Bright is well qualified to take up this work for he is thoroughly familiar with electrification of industry as applied to mining. In addition to being a graduate electrical engineer, Mr. Bright is president of the Fittsburgh section of the American Institute of Mining and Metallurgical Engineers and chairman of the General Standards Committee of the National body.

For the past three years Mr. Bright has been a member of the firm of Howard N. Eavenson and associates, consulting engineers, in charge of power application. For eight years previous to that time he was in charge of railway industrial and mining application for the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa. Mr. Bright will devote all his time to the interests of the Mine Safety Appliances Company and his advice and experience will be available to the entire mining industry.

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### Gas Home Heating

According to report from Alexander B. Macbeth, president of the American Gas Association, a fund of $500,000 for research use along heating lines has been raised. This money is to be spent during the next five years in improving gas-burning devices. Within the past five years the increase in the use of gas for heating has amounted to 64 percent. The American Gas Association appropriated $5,000 to the American Institute of Baking for research work in the adaptation of gas to various bakery needs. President Macbeth advises that "homes are now turning to gas for their heating requirements at the rate of about 100,000 a year, this figure included, of course, the large number of small installations made on the Pacific coast. New England companies are showing a very rapid growth in their homes heating business. 1,300 Baltimore homes heated by gas have replaced 20,000 long tons of anthracite."

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### Industrial Machinery Exports Increase

Except for the years during abnormal war demand, the total of United States exports of industrial machinery for 1926 exceeded any year in the history of the country, the total being $156,742,000, an increase of nearly 5 percent over the total exports for 1925. The 1926 total represented a gain of nearly 40 percent over the shipments for 1922, since which year the volume has grown steadily. Of the year's total the exports for December totaled $13,697,400.

Of the entire total of industrial machinery exported, $14,857,000 was mining machinery, or 41 percent more than in 1925, and two and a quarter times the volume in 1922. Shipments of coal cutters totaled $634,550, or more than treble the 1925 value. Exports of ore crushing and sorting machinery amounted to $4,048,270, and represented nearly double the exports of this class of equipment in 1925 and three and a quarter times the shipments during 1922. In concentrating and smelting machinery exports totaled $1,163,960 or more than double the 1925 value.

Large as was the gain in shipments of mining and quarrying machinery during the year, an even greater increase was made in oil-well equipment exports, which totaled $15,303,060 in 1926. This represented a gain of more than 50 percent over 1925 and was considerably more than three and one-half times the exports of this class of machinery in 1922.

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### British Lead Mines Re-open

It is reported to the Commerce Department that lead mines at Greenhow, near Harrogate in Yorkshire, England, have been reopened after having been closed for some 60 years. A chance discovery of what are reported to be rich veins of lead ore made when a water main was being driven through the district was responsible for the reopening of at least one of the mines.

### Handling of Electric Detonators

Electric detonators and squibs should be handled very carefully as rough handling may break the bridgewire connections. Bringing electric detonators into contact with any source of current may cause enough current to flow in the bridge wires to heat them to firing temperature. Serious accidents may result from the explosion of the detonator alone.

The best practice, and one which is required by law in several States, is to keep electric detonators in nonconductive boxes or bags until the shot firer is about to use them, and then to remove only the supply immediately needed. Electric detonators should be so removed from their boxes that the ends of the leg wires do not come in contact with any source of current; even telephone, signal, and portable electric lamp circuits carry enough current to fire them. One precaution advocated by the Bureau of Mines is to twist the bared ends of electric detonator leg wires together at the outside of the mine and keep them so until just before firing, then untwist them and connect them to the firing lines.

Electric squibs and detonators should be stored in a cool, dry place. If they are left for a long time in a warm place the waterproofing material in the insulation of the leg wires dries out and the insulation may break when the legs are bent and misfires may result in wet holes. The explosive charge of the detonators is readily affected by moisture, hence prolonged storage in a damp or wet place may cause deterioration. (Bureau of Mines.)

### Factors Influencing Products of Detonation of Explosives

The factors that affect the products of detonation of explosives, particularly the quantity of poisonous gases and combustible gases produced under mining conditions are being studied by the Bureau of Mines, in an apparatus giving products of combustion comparable to those obtained under actual mining conditions. During the past fiscal year a number of permissible explosives were studied with special reference to the effect of confinement on the poisonous and combustible gases and the effect of coal dust on the gases produced under coal mining conditions. During the present year it is planned to use different sized chambers on the apparatus, and to study effect of the combustible gases with the view to correlating the results with the gallery and flame tests.

### Hydrocyanic Acid Gas

Hydrocyanic acid gas may be purchased compressed in liquid form in cylinders or it may be generated on the spot from sulphuric acid and sodium cyanide. It is an exceedingly toxic gas which kills by paralyzing the central nervous systems, and therefore acts very quickly. A concentration of 0.01 percent is dangerous for 30 minutes exposure and 0.02 percent to 0.10 percent is fatal after a few minutes exposure. All-service gas masks, developed by the Bureau of Mines, will protect against this gas.

### Unexploded Charges in Drill Holes

Some gelatin dynamites become insensitive with age, and in consequence occasionally a part of a charge fails to explode and remains in the bottom of a drill hole, states the Bureau of Mines, in Technical Paper 400, recently issued. When this happens the unexploded part of the charge is detected only by a close inspection of the face, for its presence is not indicated by a count of the exploding charges of the round or by the fuse sticking from the hole. In hard ground where the rounds do not always break bottom, a stick or two of explosive left in the bottom of a hole may be overlooked; although drilling or picking into such explosive does not always cause it to detonate, a number of serious accidents have occurred from this cause. An explosive insensitive to detonation by ordinary detonators is always a source of danger when used underground.

Explosive left in a hole because the outer part of the charge was cut off by preceding shots is more dangerous than explosive left because it was too insensitive to detonate with the rest of the charge. There is a likelihood that a detonator may be in the charge that was cut off.

In shafts it is more difficult to take care of misfires; the broken rock from other charges falls into the holes and must be removed before reblasting—always a dangerous proceeding. Generally the rock is removed from the holes by blowing out the fine material with compressed air or with water under pressure introduced through a pipe. This procedure seems less hazardous than leaving the unexploded charge in the hole and drilling around it. It would seem to be good practice to use clay stemming in the form of cartridges in all "down" holes, because after a misfire the clay could be removed more safely than broken rock.

The general practice is to blast all missed holes or unexploded portions of charges whenever found, before any drilling or picking down is done at the face. In the past, accidents have occurred by removing unexploded charges from drill holes, but this practice is largely abandoned, and the safety rules of most mines prohibit it.

### Mine Rescue Instruction for Old Ben Employes

Safety first and mine rescue instruction will be given 5,000 employes of the Old Ben Coal Corp., at the Benton, Ill., mine rescue station, according to J. E. Jones, safety engineer for the coal company. They will be drilled in the proper way to act after an explosion and what steps to take to prolong life or effect an escape, and various first aid methods.

## OLD DOMINION SAFETY RECORD

OFFICIALS of the Old Dominion Co., at Globe Ariz., are impressing upon their employes the facts on which the company's remarkable safety record for the year 1926 are based, as shown by a graph issued by the Safety Committee, and presented in blue print for inspection by all crews. Based on the number of shifts worked, there were a little over one accident in 1926 for every three accidents in the average for the four years before, that is 1922, 1923, 1924 and 1925. There was only one fatal accident in 1926, as compared with an average of 2.75 in the four previous years.

The serious accidents recorded in 1926 totalled 31, as compared with 80.5 average a year during the four other years, and there were 72 slight accidents in 1926, as compared with 150.75 a year in the period 1922 to 1925. Total of all accidents in 1926 was only 104, as compared with average for the four other years of 234. More shifts were worked in 1926 than the average for the other years, as in 1926 the number of shifts worked was 324,633, as compared with 273,451 in the earlier years.

The percentage of reduction in fatal accidents, taken on a basis of 1,000 shifts was 70.0 percent, and for serious accidents, the reduction was 67.8 percent, and for slight accidents, it was 59.7. The blue-print poster prepared by the Safety Committee urges workers to assist in making even a better record for 1927. The operating officials at the Old Dominion to whom credit is largely due for the fine safety showing are W. G. McBride, general manager; I. H. Barkdall, mine superintendent, and D. L. Forrester, mill superintendent.

### Coal-Mine Accidents Caused 2,510 Deaths In 1926

Accidents at coal mines in the United States during the year 1926, resulted in the loss of 2,510 lives, according to statistics compiled by the Bureau of Mines. The output of coal during the year is estimated at 663,290,000 tons; hence the fatality rate per million tons produced was 3.78 as compared with 3.84 for 1925. Final returns from producing companies showing the number of employes and amount of coal produced in 1926 will not become available for several months.

Coal-mine accidents in the month of December were responsible for the loss of 248 lives, according to information received by the Bureau of Mines from the various State mine inspectors. Of this number 46 were lost in anthracite mines in Pennsylvania and 202 were in bituminous mines in various States. As the output of bituminous coal during the month was 57,671,000 tons, the fatality rate per million tons for bituminous mines was 3.50, while the anthracite rate was 6.11, based on a production of 7,528,000 tons. The combined rate for both classes of mines was 3.80.

The reports for December recorded only one major disaster—that is a disaster causing the death of five or more men. This was an explosion on December 9, at Francisco, Ind., causing the death of 37 men. There were 16 of these "major" disasters during the year and they caused 348 deaths, as compared with 14 disasters in 1925, in which 270 lives were lost. The per-million-ton death rate, based exclusively on these major accidents, was 0.52 in 1926 and 0.46 in 1925.

An examination of the principal causes of accidents in 1926, shows a very slight reduction in the death rates per million tons from falls of roof and coal and for explosives, and a slight increase in the rates for haulage accidents and for gas and dust explosions. The rate for electricity remained unchanged.

### Methane Gas Detector Demonstrated

Prof. E. K. Judd and H. C. Stelling, of the Union Carbide & Carbon Corp., assisted by J. K. Mabbs, of the Linde Air Products Corp., gave to a large group of Utah coal mine operators in Salt Lake City early in February, a demonstration of Professor Judd's new device for the detection of methane gas in mines. The gas detector was produced by Professor Judd after two years of research, and the Utah operators who saw its trial believe it to be a marvellous advance in safety equipment.

A platinum filament, a dry cell battery together with a recording dial tuned to register the presence of less than 1 percent of methane gas make up the device. The filament is encased in a quadruple layer of wire gauze, and is kept glowing by battery heat. The presence of methane gas increases the temperature of the filament, the variations in temperature being registered on the dial, in view of the operator. A sufficient variation shown on the dial will serve as warning for the emptying of a mine under tests. Professor Judd announced to the Utah operators that he has well under way to perfection a device for "dissipating" methane gas.

### PROGRESS OF ELECTRIC SHOT-FIRING

**A large percentage of the blasting in quarries, shafts and tunnels, and from 15 to 25 percent of the blasts in mining operations, are set off electrically. Electric shot firing is only one method of igniting explosives, but it is rapidly spreading, and, because of certain inherent safety features, should be encouraged.**

**Electrical problems of many kinds must be solved in dealing with the various phases of electric shot-firing. Success in using an electric detonator is closely linked with the resistance of its bridge, the resistance of its leg wires, and the insulation of its current-carrying parts. The proper layout of a circuit where a number of shots are to be fired simultaneously depends not only on the types of detonators that are used and their arrangement and interconnections, but also on the size and insulation of the wire leading back to the source of power, and even on the source of power itself. Various types of electric shot-firing machines have been developed, and these offer still another field for study.**

**In investigations of electric detonators and electric blasting equipment, the oscillograph is valuable because it can record electrical activity over very short intervals of time. By its use more complete information about electrical performance can be obtained than by any other means.**

**The Bureau of Mines advocates electric shot-firing because, when properly used, it is the safest and most efficient practice. Electric firing permits absolute control of the time when any shot shall fire, and the order in which several shots shall fire.**

**The results of an investigation of electric-shot firing in mines, quarries and tunnels are contained in Bulletin 240, by L. C. Ilsley and A. B. Hooker, copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.**

### Relative Safety of Cushioned Blasting

The relative safety of cushioned blasting as compared with shots in which no air space exists between explosives and stemming is being studied by the Bureau of Mines at its Pittsburgh experiment station. During the past fiscal year series of tests have been partly carried out to determine the charge limit of a permissible explosive in 8 percent natural gas-air mixtures under the different methods of loading in the borehole, and using different kinds of stemming. During the present fiscal year it is planned to complete the above series and include natural gas-air mixtures of less than 8 percent natural gas.

### Explosibility of Natural Gas-Air Mixtures

At its Pittsburgh experiment station, the Bureau of Mines is studying the determination of the approximate lower percentage of natural gas in mixture of natural gas and air which would be ignited and explode when explosives were fired from a cannon into the mixture. Four series of tests were run during the past fiscal year, using an electric igniter, 3-F black blasting powder stemmed, and 40 percent straight nitroglycerin dynamite unstemmed to ignite the mixture. The fourth series studied the effect of turbulence on the lower limit of explosibility. During the present fiscal year it is planned to supplement the work already done so that the lower limits can be more accurately defined.

### West Virginia Safety Meeting

Coal companies operating in West Virginia paid $1,047,000 to the state last year in compensation for miners killed in their mines, it was stated by Robert M. Lambie, chief of the state Department of Mines, before a meeting of 200 mine officials at Clarksburg recently. Under the new rate now in force, Mr. Lambie stated the companies would have paid $1,455,000. There were nearly 100 more fatalities last year than in 1925. He spoke at length on fires and explosions from a technical standpoint.

Other speakers on safety methods included Dan Harrington, chief of the safety service of the Bureau of Mines; W. H. Forbes, of Huntington, assistant engineer with the bureau, and Lee J. Sandridge, of Philippi, president of the Meriden Smokeless Coal Co.

The James Douglas Memorial Safety trophy, awarded annually to the branch of the Phelps Dodge Corp., with the smallest number of lost time accidents, has been presented to the Moctezuma Copper Co., Nacozari, Sonora, Mex.

For the year 1926, the number of accidents was less than one-half of the number during 1925.

### Lead Poisoning in Mining of Lead

A survey of lead poisoning conditions in the lead mining industry of Utah has been conducted by the Bureau of Mines. The survey, which was made at the request of mine operators and miners, covered a period of two years, and indicated lead poisoning rates of 0.83 and 0.50 per 1,000, for the respective years, for the entire population of the state.

Virtually all lead poisoning at mines is contracted through inhaled lead ore dust, according to Dr. Arthur L. Murray, surgeon, in a report just made public by the bureau. The carbonate ores are the most frequent cause of lead poisoning among miners. The sulphide ores may cause lead poisoning when mined dry in poorly ventilated places. Lead poisoning in mining can be reduced to a minimum by efficient ventilation, wet drilling, and the sprinkling of muck piles before loading.

The conditions under which lead ore is mined and the nature of the ore have a direct bearing on the incident of lead poisoning among miners.

The stage of development of mines working large deposits of lead ore often influences the prevalence of lead poisoning in such mines. Generally speaking, in Utah mines the more soluble salts of lead occur close to the surface and with few exceptions the upper levels of the mines are dry and dusty; therefore, in the earlier stages of the development of the mine, when the work is confined to a few hundred feet below the surface, the lead hazard is greatest.

The situation of mine openings and the efficiency of the mine ventilation play important parts in exposure to lead poisoning. Where the working faces are distant from good air courses, or where for any reason the movement of air at the working face is sluggish, the lead dust thrown into the air through drilling, blasting, and mucking, remains suspended in the atmosphere and is breathed by the miners for considerably longer periods of time than it would be if the ventilation at the faces was good, which at the outset would cause greater dilution of the dust in the air and tend to remove dust-laden air from the working face with greater rapidity.

Heat and humidity may also cause predisposition to lead poisoning. In those sections of mines where the temperature is high and the humidity great, men wear little clothing and even strip to the waist, thus exposing a large part of the body to lead-laden dust. Men working under these conditions usually perspire profusely, and thus are more likely to absorb soluble salts of lead through the skin. Then, too, unless they bathe after each shift the lead dust accumulated on their bodies becomes dry and they are liable to inhale lead dust while changing clothes and in sleeping quarters.

The method of drilling and handling muck may be a decided predisposing factor in causing lead poisoning. Dry drilling and the loading of dry muck creates much more dust than wet drilling and the shoveling of muck from well-sprinkled piles. The bureau considers that the use of wet drills exclusively, the thorough wetting of muck piles before they are loaded out, and adequate ventilation, will reduce to a minimum the hazard of lead poisoning in mines.

The results of this survey of lead poisoning in the mining of lead in Utah are given in Technical Paper 389, copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

### State Insurance Commissioners Would Better Coal-Mine Compensation Insurance

A committee of state insurance commissioners, headed by Joseph Button, of Virginia, appeared before the meeting of the National Council on Compensation Insurance, in New York City early in February and asked that steps be taken for bettering facilities for insuring coal mines against liability for the payment of compensation benefits. A resolution adopted by the National Convention of Insurance Commissioners at Los Angeles in November, 1926, was presented to the meeting. The resolution declared that insurance organizations which formerly carried more than half of the business of insuring coal-mine owners against injury to their workers have withdrawn from the field. "It is necessary to ascertain whether this type of business may be made attractive to private insurance without detriment to the public interest or whether the states must assume the burden of insuring this type of risk," the resolution said.

The National Council on Compensation Insurance appointed a committee to confer with the insurance commissioners in regard to rates for coal-mine risks.

The National Convention of Insurance Commissioners will meet again in May, at Richmond, Va.

### Remarkable Safety Record

The West Virginia Division of the United States Coal and Coke Co., is credited with the most remarkable safety record in the history of coal mining, according to news from Welch, W. Va., covering announcemnt just made by W. C. Stratton, chief engineer. Only three men lost their lives in 1926 in the production of 4,657,352 tons of coal, of only one fatality for each 1,500,000 tons of production.

## SAND FLOTATION INSTALLATIONS

(*Continued from page* 201)

able to guarantee the percentage of ash in our product we obtained for it a much higher price than did our competitors, who used other methods of cleaning their product.

At the same time the salable material sent to waste was negligible; that is, less than 1 percent of the total could be classed as bone and there was practically nothing that could be classed as coal.

We have at times handled through this plant fresh-mined coal alone and fresh-mined coal mixed with various proportions of bank material and have secured correspondingly satisfactory results.

## SAND FLOTATION PROCESS FOR CLEANING ANTHRACITE AND BITUMINOUS COAL

(*Continued from page* 214)

August 31, 1926, is given below, all data being on a net ton basis:

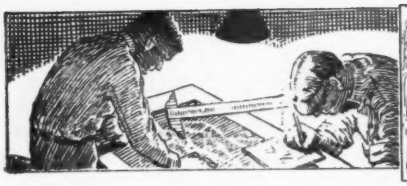
| | |
|---|---|
| Total tons prepared and shipped | 423,733.00 |
| Total days worked | 183.00 |
| Average days worked per month | 22.85 |
| Average tons shipped per day | 2,315.48 |
| Maximum production in one working day of 7 hours, 21 minutes | 4,441.00 |
| Total tipple and loading crew | 23 |
| Allocated preparation crew | 6 |
| Sand consumption, pounds per net ton of coal shipped | 2.00 |
| Power consumption, K. W. hrs. per net ton of coal shipped | 0.892 |
| Preparation man-hours, per net ton of coal shipped | 0.021 |
| Preparation maintenance cost, per net ton of coal shipped, cents | 1.5 |
| Total capital charges, per net ton of coal shipped, cents | 2.0 |

The above figures cover the entire operation of unloading, cleaning and screening, except in those items noted under preparation, which latter cover cleaning and screening alone.

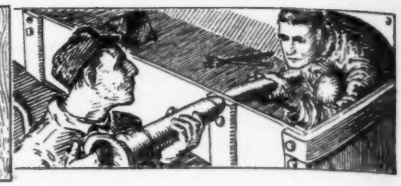
### Sources of Dust in Coal Mines

The most prolific source of coal dust in coal mines is dry undercutting of the coal, the Bureau of Mines has ascertained in the course of an investigation covering 15 representative coal mines in six coal-mining states. It was found that dust in the surrounding air resulting from dry undercutting operations averaged 9,810,000,000 particles per cubic meter of air. Where water was applied to the cutter-bar, dust in the air caused by undercutting the coal averaged but one-seventh of the amount caused by dry undercutting. The information brings out clearly the importance of using water in undercutting operations as a means of reducing the coal-dust hazard, a big factor in mine explosions.

Details are given in Serial 2793, "Sources of Dust in Coal Mines," by J. J. Forbes and Alden H. Emery, which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.



# WITH THE MANUFACTURERS



### Colorado Fuel & Iron Co. Now Operating With New Electric Drive

The largest steel plant in the West, that of the Colorado Fuel & Iron Co., at Pueblo, Colo., has now started operation with its new electrical equipment. This company recently made a complete (with the exception of its blooming mills) change-over from steam to electric drive, using electricity generated on the premises in the largest industrial power plant in the Rocky Mountain region.

The company was incorporated in 1892 and, until a few years ago, all power used in the plant was derived from steam engines. Electrification was first considered during the period following the war, and the initial program included a power plant, the electrification of the rod and 10-inch mill, the 14-inch mill and the rail mill.

All the main electrical equipment, including the turbine generators in the power house, was furnished by the General Electric Co. Among the items are three 10,000-kilowatt turbine generators to furnish power for the various mills, and two 1,000-kilowatt motor generators to furnish direct current to the power house and the adjacent mills.

An outstanding feature of the fuel supply is blast furnace gas cleaned by electric precipitators. Powdered coal is used as a standby fuel. The reduced steam requirements resulting from electrification, together with the more efficient use of blast furnace gas, has resulted in shutting down approximately 85 percent of a boiler plant containing 30 500-H.P. hand-fired boilers.

The switch house contains three busses, one main 6,600-volt bus for supplying large blocks of power to the various mills, an auxiliary 6,600-volt bus for supplying smaller blocks of power to various outlying operations, and a 2,300-volt auxiliary bus for the power house auxiliaries. All power leaves the power house at 6,600 volts, as generated and as used by all the large a. c. motors.

The rod and 10-inch mills, the first in operation, are located in the same building and use the same billet heating furnaces and continuous mill. This mill was originally driven by four reciprocating engines, now replaced by two 3,000-H.P., slip-ring, induction motors; two 1,000-H.P. motors of the same type; two 1,500-H.P., d. c., adjustable speed motors, and a 300-H.P. motor of the same type. One of the 1,500-H.P. motors, located in a separate motor room, is supplied by a 1,600-kilowatt syncronous converter also located in the same room. The other 1,500-H.P. and the 300-H.P. motor, located in the main engine room, are supplied by another synchronous converter of 1,600 kilowatts capacity. All the a.c. motors drive the stands through reduction gears, whereas the d.c. motors are direct connected.

The 14-inch merchant mill was originally driven by a single engine connected to the continuous stands with rope drives connecting the intermediate and finishing stands. This was replaced by a 1,500-H.P., d.c., adjustable speed motor connected directly to the intermediate stands with a rope drive to the continuous stands, and a similar 750-H.P. motor directly connected to the finishing stands. A 1,600-kilowatt synchronous converter, a duplicate of the two in the rod and 10-inch mills, supplies power to these two motors.

The rail mill was formerly driven by an engine on the roughing stand and a second engine on the intermediate and finishing stands. These two engines were replaced by a 2,000-H. P., a. c., slip-ring, induction motor on the roughing stand and a similar 3,000-H. P. motor on the intermediate stands. The finishing stand was separated from the intermediate, and a 1,200-H. P., a. c., slip-ring motor now drives this stand. All these motors drive the mills through reduction gears, and in the case of the roughing and intermediate stands, the original engine flywheels were mounted on new bearings and connected to the mill side of the reduction gears. Permanent resistance is inserted in the secondary of these motors to take advantage of the flywheel effect.

Large economies are expected in power, labor and maintenance by the electrification. The old engines which exhausted to atmosphere were uneconomical and their salvation required a larger number of men than is required for the motors.

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### How to Seize Wire Rope

The end of an ordinary wire rope should have at least three seizings to prevent unlaying, which, if it occurs, would render the rope useless, says the American Cable Co., in a recent news release. They further state that the seizings may be replaced by fittings if they are designed to prevent unlaying of the rope.

The following instructions are given:

1. Wind the seizing wire on the rope by hand, keeping the coil together and considerable tension on the wire, winding over from left to right.

2. Twist the ends of the wire together counter-clockwise by hand so that the twisted portion of the wires is near the middle of the seizing.

3. Using Carew cutters, tighten the twist just enough to take up the slack. Do not try to tighten the seizing by twisting.

**4. Tighten** the seizing by prying the twist away from the axis of the rope with the cutters.

5. Tighten the twist again as in 3. Repeat 4 and 5 as often as is necessary to make the seizing tight and rigid. Cut off the ends of the wires, and pound the twist flat against the rope.

Any annealed low carbon steel wire may be used for seizings, the size ranging from No. 10 to No. 18, depending upon the diameter of the rope. This method is taken from the United States Government Master Specifications No. 297.

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### Large Precipitator for Trenton Channel

The first and only large installation of equipment for the electric precipitation of ash in a powdered fuel boiler plant is being installed at the Trenton Channel power plant of the Detroit Edison Co. The installation, having what will probably be the highest power rating of any single electric precipitation of plant ever built, is being made under the supervision of the Research Corporation of New York City, and involves the use of the Cottrell process.

The smoke given off from the Trenton Channel powdered fuel boiler plant carries with it a large amount of fine ash which, if it were not removed in some way, would result in the distribution from the stacks of many tons of ash over the surrounding countryside. By means of the new precipitator this will be practically eliminated.

Nine precipitator units will comprise the final installation, each being served by two 25 kv-a. electrical sets. Two precipitator units are already in use and the remainder will be installed early this year.

The high voltage power will be supplied from 18 specially designed, 25-kv-a. transformers, of which 14 units are now under construction at the Pittsfield plant of the General Electric Co. These units

will step up the 220-volt, single-phase, 60-cycle power supply to 75,000 volts. The high voltage will then be passed through mechanical rectifiers built by the Research Corporation and each driven by a single-horsepower, ball-bearing, synchronous motor of special design and furnished by the General Electric Co. The high voltage direct current from the rectifier will be applied directly to the treaters.

The precipitators are of the graded resistance type, consisting of parallel grounded concrete plates between which will be suspended anodes connected to the negative side of the direct-current circuit. The positive side of the direct-current circuit will be connected to the concrete plates and a corona discharge will flow from the suspended anodes to the concrete cathodes.

The smoke exhausted from the boiler plant will pass between the concrete plates and the suspended ash will be ionized by the corona discharge and deposited on the concrete plates whence it will be removed periodically by mechanical means, dropping into hoppers below. Periodic removal from the hoppers will complete the process.

By means of a number of taps in the low-voltage winding of each transformer, it will be possible to select the best operating voltage at which the precipitators will operate. These taps will provide, besides the 75,000 volts, voltages of 70,000, 65,000 and 55,000.

### New G. E. Motors for General Application

A new type of induction motor which, with its control, is even simpler to operate than the ordinary squirrel cage motor and compensator, is announced by the General Electric Co. A complete line of these motors, bearing the type designation FT and ranging in ratings from 7½ to 50 horsepower, has been placed on the market.

The new motor marks the culmination of several years of investigation, development and research in the endeavor to meet the demand for a motor embodying simplicity, reliability, low cost and line switch control involving full voltage starting. While large numbers of high reactance motors of somewhat similar characteristics have been built and applied during the period of development, this is the first co-ordination of a complete line for general purpose application.

The FT motor is in general suitable for application wherever the ordinary squirrel cage induction motor with a compensator has been used. It is designed to start on full voltage giving slightly higher starting torque but approximately the same starting current as the ordinary squirrel cage induction motor started with the compensator connected to the 80 percent tap.

In appearance the new motors are the same as the ordinary squirrel cage induction motor. Rotors are of the cast aluminum type with bars so shaped and located in the punchings as to give a high reactance effect at starting. Starting current is within the N. E. L. A. limitations up to and including the 30-horsepower size.

Control apparatus required is very simple. An ordinary line switch of proper capacity can be used, but, in order to obtain proper overload and under-voltage protection, the motors are recommended for use with magnetic starting switches using push button control. Where necessary, on the larger sizes, a compensator or resistor starter may be used as in the case of the ordinary squirrel cage induction motor.

The advantages are low cost, simplicity, reliability, low starting current permitting the use of a line switch, elimination of the possibility of abuse by inexperienced operators, and ready adaptation to automatic control by pressure governor, float switch, etc.

### Combustion Engineering Opens New Offices

The International Combustion Engineering Corporation has recently moved into its new quarters, International Combustion Building, located on Madison Avenue between 35th and 36th Streets, New York City, which is said to be the sixth largest office building in the country.

A part of the space in International Combustion Building will be used by the company in completing the design and engineering detail of its first large orders for apparatus for the distillation of coal at low temperatures, developed by Dr. Runge and Samuel McEwen and known as the McEwen-Runge process. There are a number of processes that have been developed for this purpose, over 60 of which have been tried out in one way or another in Great Britain, but it remained for International Combustion Engineering Corporation to sell two great plants in Great Britain complete equipment for the erection of a proven commercial and continuously operating device for extracting the oil, tar and gas and other ingredients from coal before the coal is burned.

A half floor in the building in addition to this has been turned over to a department under the direction of Dr. Wm. L. DeBaufre, one of the most eminent scientists in the country for perfecting an entirely new phase of power plant development which has been continuously sought for many years and which combines the use of pulverized coal and low temperature distillation.

### Larger Quarters for Hyatt-Pittsburgh

Pittsburgh offices of Hyatt Roller Bearing Co., recently named headquarters for the Central Sales Division, are now located at 806 Fulton Building, that city. They were formerly at 1352 Union Trust Building.

The new location amply provides for the increased sales and engineering forces of the Central Division functioning under the direction of B. H. Lytle.

H. R. London, a new member of the Pittsburgh force, is now operating in the industrial field of W. L. Iliff.

### Trico Now Carries Complete Stock in West

In order to efficiently serve the West coast, The Trico Fuse Mfg. Co., Milwaukee, Wis., manufacturers of Trico Renewable Fuses, now carries a complete stock of all Trico products with their Seattle, Wash., representatives, the Albert S. Knight Co., 2203 First Ave., South.

This is in addition to the complete stock carried by their Los Angeles, Calif., representatives, the Coast Electric Supply Co., 222 South San Fedro St.

### General Electric Supplementary Compensation

Supplementary compensation totaling $1,358.669.89 was distributed in February to 30,518 factory and office employes who have been in the employ of the General Electric Company for five years or more. The distribution was based on five percent of the employe's earnings for the six months from July 1 to December 31, 1926. Payments were made in General Electric Employes' Securities Corporation bonds or in cash, as the employes desired. The largest amount was paid to Schenectady employes, who received $452,489.86.

### duPont Heads Technical Expansive Convention

Important questions in regard to railroad and road building work, contracting, quarrying, coal and metal mining and special uses of explosives were among the questions discussed at the technical explosives convention of the du Pont Co., held in Wilmington, Del., January 25, 26 and 27. The convention was regarded as one of the most important ever held by the Explosives Department of the company. It was attended by representatives of the technical force at the home office and in the field, by officials of the administration, chemical, sales and manufacturing forces. There were also present men from Nobel Industries, Ltd., of England, the Canadian Explosives, Ltd., of Montreal, and the Canadian Giant, Ltd., of Vancouver, Canada.

Papers were read on high speed tunneling methods being used at the Great Northern Tunnel at Scenic, Wash., the practices employed in Muskeg blasting for road construction, limitations of the well drill method of blasting, how to handle misfires and a review of unusual blasting conditions and unusual blasts, including some of the most important explosives engineering feats performed in the United States in recent years. Practically every phase of coal mining where explosives were used was covered. Pellet powder, a new explosive produced by the company, was discussed and its action in the field reported by the technical men from all sections where this powder is employed. The new powder is regarded as a great step forward in safety and economy. Other improved explosives manufactured by the company were also reviewed and their results analyzed.

### International Combustion Engineering Corporation Acquires the Heine Boiler Co.

International Combustion Engineering Corporation has officially announced the acquisition of the capital stock of the Heine Boiler Co., one of the oldest and leading water-tube boiler manufacturers in the United States. This acquisition gives the International Combustion Engineering Corporation large boiler shop facilities at St. Louis, Mo., and Phoenixville, Pa.

### Hyatt Names New Sales Manager and Chief Engineer

Mr. H. J. Forsythe, president of Hyatt Roller Bearing Co., Newark, N. J., announces the appointments of Mr. H. O. K. Meister as general sales manager, and Mr. A. W. Scarratt, as chief engineer.

Mr. Meister joined the Hyatt forces more than 14 years ago, locating first as an engineer at the house home office in Newark. Later he was transferred to the Chicago office where, after a few years, he took over the supervision of Hyatt sales work in the western territory.

Eighteen months ago, Mr. Meister was appointed assistant sales manager and remained in headquarters at Newark, where he will continue to be located as general sales manager.

Mr. Scarratt is well qualified to take over the duties of chief engineer on account of his past experience in the design and construction of automotive, tractor, railroad and industrial equipment. He joined the Hyatt engineering staff a few months ago as assistant chief engineer. Mr. Scarratt will remain at headquarters in Newark.

Both Mr. Meister and Mr. Scarratt are very active members of the society of Automotive Engineers and have held important offices in the sections where they were previously located.

### New Catalog on Pulverizing

Raymond Bros. Impact Pulverizer Co., has issued a new catalog which is unusual in that it gives in detail various pulverizing problems and illustrates the different pulverizers as best adapted to various kinds of materials. It also includes the description of a complete air separating plant. Copies may be had from Combustion Engineering Corporation, 200 Madison Ave., New York City.

### Coal Washing Machine for Carnegie

A counter-current demonstrator machine for washing coal has been donated to the Carnegie Institute of Technology by the Hydrotator Co., of New York., Professor James Aston, head of the Department of Mining and Metallurgical Engineering, has announced. The equipment, which is valued at about $4,000, has been installed in the mining laboratories of the department in the Science Building.

## SAND FLOTATION AT ST. CLAIR COAL CO.

(*Continued from page* 206)

coal shipped per eight hours but it has not reached this tonnage except at rare intervals chiefly due to the lack of coal from the mine.

The labor required to operate the breaker is made up as follows:

| | |
|---|---|
| 1 foreman | 2 classifier attendants |
| 1 dumpman | 3 classifier trappers |
| 1 helper on dump | 1 rock inspector |
| 4 men on picking table | 1 coal inspector |
| 5 shaker attendants | 4 car runners |
| 1 man cleaning up | 1 man at sand pumps |
| 1 oiler | 1 at breaker pumps |
| Total ..... 27 men | |

An ample supply of water has been found necessary at St. Clair and 3,500 gallons per minute are pumped into the breaker with a pressure varying from 10 to 15 pounds per square inch at the top of the cones with all machinery in full operation. Too high a pressure does not give good results in the cones and less than the above pressures make it difficult to maintain the proper gravity.

Ample screening capacity is very important in sand flotation as the coal must be thoroughly cleansed of sand before going to the pockets. This is particularly true of the sizes below pea coal. These sizes should pass over screens in a thin layer and at a rather slow velocity in order to maintain a careful separation of coal and sand.

By paying careful attention to the removal of silt before the coal enters the cones, and in addition having a shaker in the circuit over which at least a portion of the sand in the system can pass continuously, the entire process can be handled very smoothly.

Clean sand is vital to success and every effort must be put forth to separate from the sand all fine coal and silt.

While labor costs for operating the plant are low, maintenance charges are not as favorable. This is due to the heavy wear of the sand solution on draglines, pipes, valves, and any machinery subject to the erosive action of the sand. Acid water also contributes to the rapid cutting out of pipes, valves, shaker segments, etc. By neutralizing the water used, savings can, no doubt, be effected, and a method to accomplish this is now under consideration at this plant.

Previous to July, 1925, a wooden jig type breaker of conventional design common throughout the anthracite region was in operation at St. Clair. A comparison of the two outfits is interesting and shows some advantages in favor of sand flotation.

Taking two typical months, which are very similar as far as working time and coal dumped are concerned, we find that the prepared coal in the new breaker was increased 6 percent, the yield per mine car dumped remained practically constant, while the percentage of ash content in the smaller sizes dropped an average of 10 percent. In spite of the fact that more refuse was removed from all sizes, the total yield per mine car changed very little. This can be accounted for in the difference in breakage experienced in the two plants.

The saving in labor in the new plant is very marked over the jig breaker. The latter required from 80 to 90 men and boys to operate it, while the former needs only 27 men. In the jig type breaker satisfactory cleaning of the small sizes was never obtained, while with sand flotation comparatively little trouble is experienced in this respect.

The power required to run the sand flotation plant totals 600 h.p. This is practically the same as was used by the jig breaker. The new plant is driven with individual motors, while the old breaker used a single large motor. Very little, if any, saving in power consumed is noted in the new breaker.

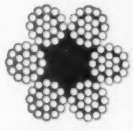
Sand flotation has been successful at St. Clair on coal which is difficult to clean, but it requires careful attention and close supervision to turn out a product which is clean, well sized, and of uniformly good quality.

# "HERCULES" RED-STRAND

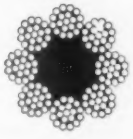
REG. U.S. PAT. OFF.

# WIRE ROPE

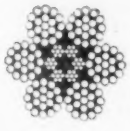
## Made to Meet All Conditions



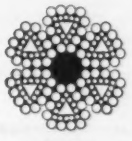
A wire rope used on a mine hoist does not work under the same conditions as one used on an incline, consequently if best results are to be had the rope must be suited for the work it is to do.

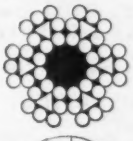


In addition to being of the very highest quality, "HERCULES" (**Red Strand**) Wire Rope is made in various types and in both the Round Strand and Patent Flattened Strand constructions. We are therefore in position to furnish the right rope for any work.



Tell us how you use wire rope and we shall be glad to suggest the construction for best results.





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**AUTOMATIC SWITCH THROWERS**
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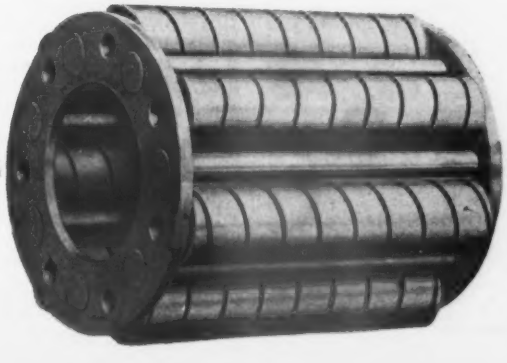

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Howells Mining Drill Co., Plymouth, Pa.
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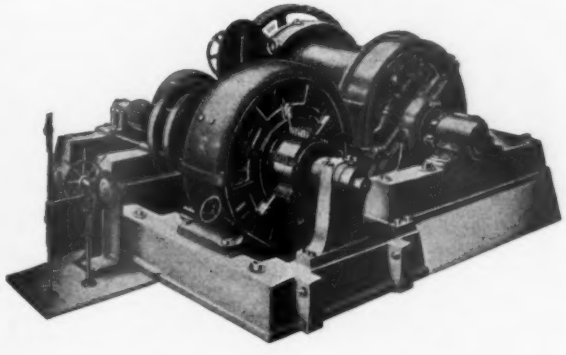

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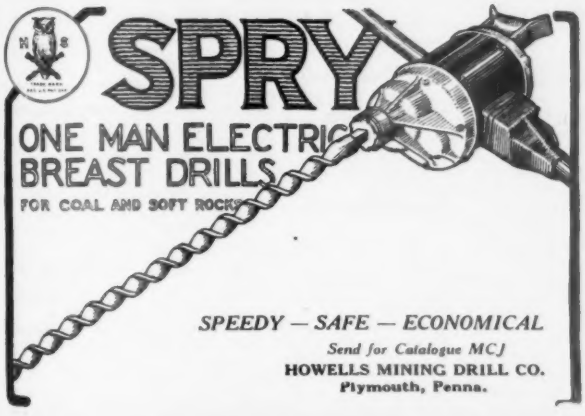

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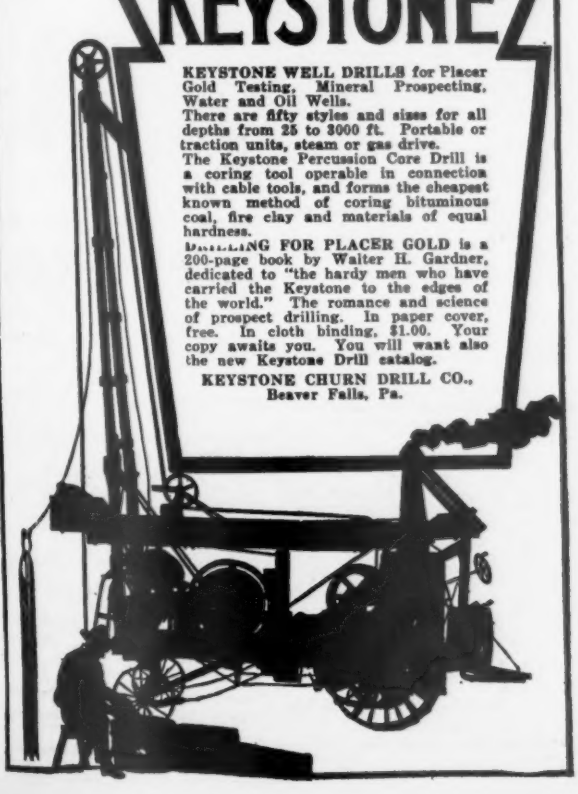

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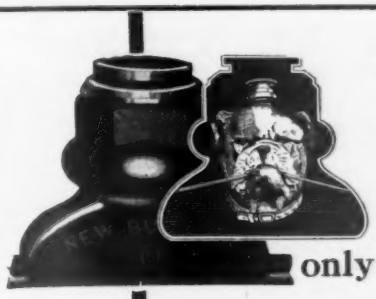

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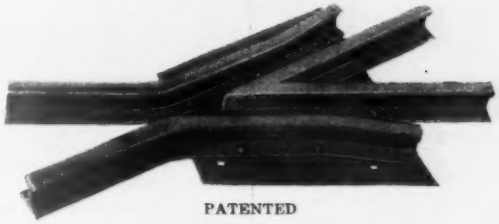

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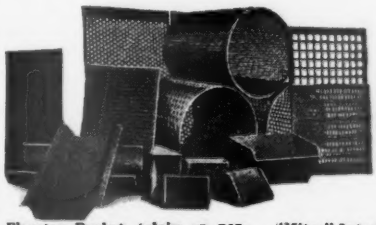

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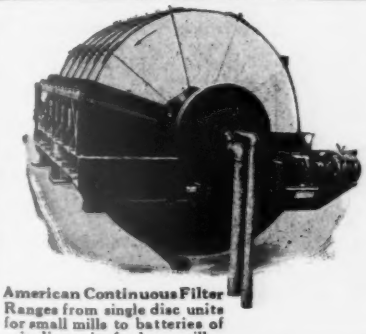

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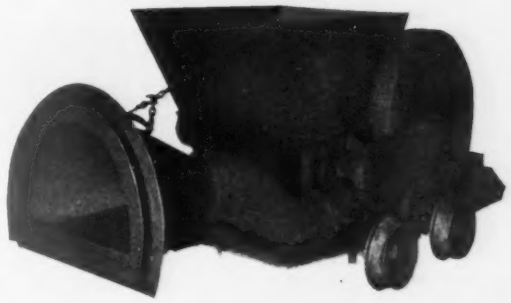

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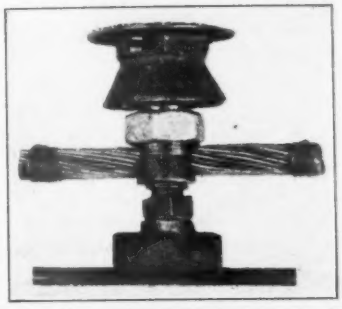

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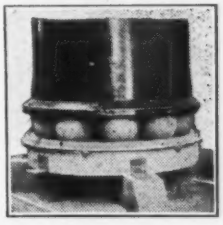

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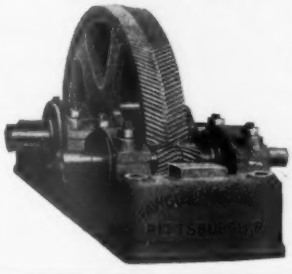

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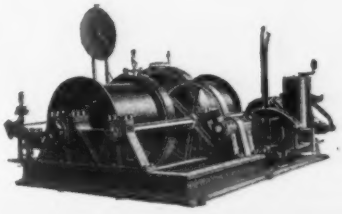

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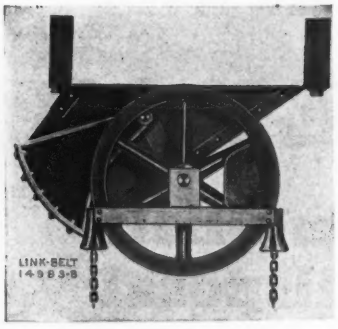


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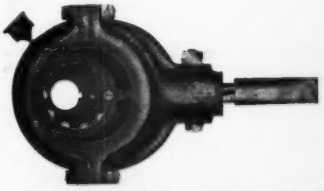

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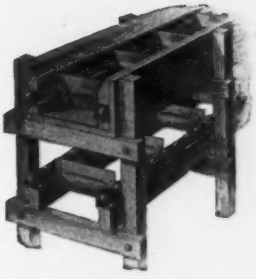

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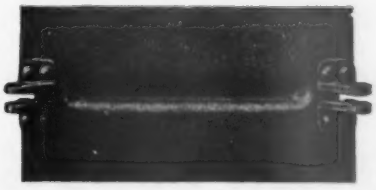

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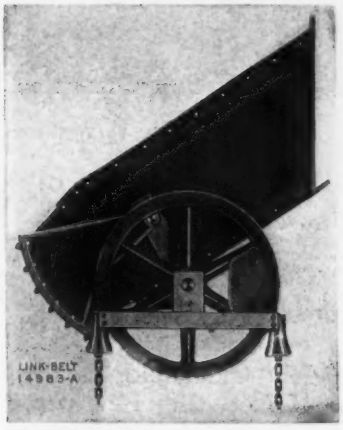


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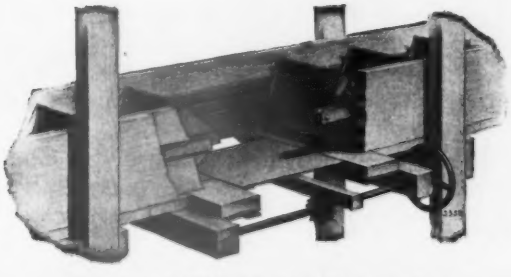

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An inclined apron conveyor withdraws the coal from the dump weigh hopper and carries it to the shaker screens, which screen out lump, nut and slack sizes. The lump and nut sizes are cleaned on picking tables.

Link-Belt Engineers study your market to insure the design of equipment which will most successfully meet selling competition.

Our new Book, "Handling and Preparing Coal at the Mine," will give you a comprehensive idea of how we have solved preparation problems, in practically every coal field in North America.

Ask our nearest office for a copy of Book No. 555; its 72 pages are crammed full of progressive ideas.

2344

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# FOURTH ANNUAL COAL CONVENTION AND EXPOSITION

**SIXTY**

*men from seventeen states—headed by Mr. Ezra Van Horn, of the Clarkson Coal Co., of Cleveland, Ohio—make up the representative Program Committee that is working out the practical and important discussions briefly outlined in the next column.*

Coal preparation—wet and dry methods—will occupy three sessions of the discussions, mechanical loading three sessions, developments in mine safety and cutting and shooting each one session. These subjects have been selected following a nation-wide poll of the industry. The meetings will be held in a new auditorium specially constructed for the purpose in the south wing of the Music Hall.

**FORTY**

*two additionals booths have been provided in the South Hall and already nearly ninety percent of all space has been contracted for by seventy-nine manufacturers. It will be a record-breaking exposition of coal mining equipment.*

## Cincinnati, Ohio

### May 16-20, 1927

*For further information address*

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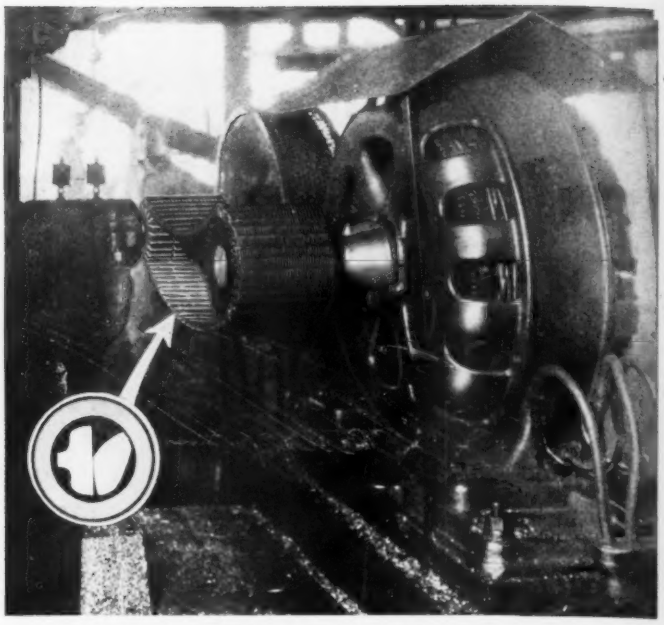

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